SAMPLING AND ANALYSIS PLAN
GROUNDWATER MONITORING PROGRAM

OMNISOURCE SOUTHEAST
INDUSTRIAL LANDFILL
KERNERSVILLE, NORTH CAROLINA

REVISED DECEMBER 2011

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12/21/11

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1.0 INTRODUCTION

The OmniSource Southeast facility in Kernersville, North Carolina includes a private industrial landfill permitted by North Carolina for the disposal waste from the metals recycling operation. The landfill was established in the early 1970's for the disposal of waste from the metal shredding process (shredder residue). Exhibit No. 1 provides a location map of the facility.

The original monitoring well network at the OmniSource facility consisted of four wells (MW-1, MW-2, MW-3, and MW-4) which were installed in 1989. The upgradient well for the monitoring network was MW-1. It was located just west of the active scrap processing yard in order to provide protection for the well and to be sure the well was monitoring background conditions. The other three wells are downgradient wells and were installed close to the toe of the landfill. The locations of these wells were selected after consultation with the staff of the Solid Waste Section of the Department of Environment and Natural Resources (NCDENR). One significant criteria for the selection of well locations was accessibility. There were some old, generally unmaintained, logging roads on the property north and east of the landfill. Due to the steepness of the terrain and the property boundaries existing at the time, downgradient wells MW-3 and MW-4 were positioned very close to the toe of the landfill. The location for MW-2 was selected based on accessibility from the logging road on the east side of the landfill.

In 2001, another downgradient well, MW-4D, was installed. This well was deeper than the adjacent wells being screened at a depth of 58 to 68 feet BGS. This well was installed to evaluate possible vertical changes in water quality. At the same time that this well was installed, well MW-1R was installed to replace MW-1. This replacement was necessary to protect the well from expanded scrap processing activities close to MW-1. Beginning in 2001, MW-4D was sampled in place of MW-4.

The existing monitoring well network was sampled on a semiannual basis from 1990 (except when the site was closed due to bankruptcy by a former owner) until the initiation of the landfill mining operation.

Background information relating to site geology and hydrogeology is attached in Appendix A. The information included is taken from the 1997 document *Landfill Evaluation* previously submitted to NCDENR.

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2.0 PROPOSED CHANGES IN MONITORING WELL NETWORK

At present, the material in the landfill is being reprocessed to recover buried metal using technology which was unavailable at the time the shredder residue was generated. As the material is placed back in the landfill, it is being configured in such a way to augment final closure of the landfill. In preparation for the final closure of the landfill, a significant modification to the groundwater monitoring network is being proposed.

- The existing monitoring wells (MW-1R, MW-2, MW-3, MW-4 and MW-4D) will be abandoned and the appropriate report filed with NCDNER.

- Two new monitoring wells will be installed inside the compliance boundary close to the existing natural gas pipeline easement (see Exhibit No. 2). Because the landfill was permitted prior to 1983, the compliance boundary established by the Subchapter 2L rules is 500 feet rather than the 250 feet established for new landfills. Since MW-2 was installed in 1989 and has not been maintained in a number of years, it will be replaced with a new well as close to the original location as possible. MW-1R will be preplaced with a new monitoring well as the existing well was not consistent in producing sufficient water for monitoring events.

- The screened interval for the new upgradient well and the replacement well for MW-2 will have to be determined in the field. The existing upgradient well was screened at the top of the water zone encountered during the installation process. It was later discovered that the water level fluctuations were substantially greater than available data indicated. Consequently, it is proposed that the top of the screened interval for this will be 20 feet below the top of the water zone. For the replacement for MW-2 the screened interval will be determined based on the actual location for the well. The topography in this area is steep and the area is wooded with a number of older trees. The location will be based on accessibility of the drill rig. The possible variation of ground elevation is 30 ± ft. Because the groundwater elevation in this area historically has been fairly consistent, it is proposed that the top of the screened interval be set at about 2 ft. below the top of the water zone.

- The screened intervals for the two downgradient wells adjacent to the pipeline right-of-way are proposed to use the same criteria for the replacement well at location 2.

- Once the new wells are installed, a licensed surveyor will be engage to survey the location and the elevation of each well. Each well will have a permanent identification plate attached to the protective casing.

- Exhibit No. 2 presents the proposed locations for the new monitoring wells and includes the proposed locations for monitoring surface water. The downstream

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location was selected to be close to the two new monitoring wells for ease of access. The exhibit presents two possible locations for upstream/background surface water monitoring. The first location is an upstream location located south of the location of MW-2. The potential problem with this location is that the drainage upstream of the MW-2 location has been observed dry on numerous occasions. The water source for this drainage consists of several small springs located on either side of the drainage. The further downstream, the more likely it is to encounter flowing water. However, further downstream also makes more likely impact from the landfill. As an alternative, it is proposed to sample a surface drainage located northwest of the landfill site and on the opposite side of the ridge on which the landfill is located. This drainage is a blue-line drainage and is crossed by the pipeline right-of way which will allow access for sampling. Exhibit No. 3 is a 2010 aerial photograph of the site.

- All new monitoring wells will be 2" PVC casings with the top of the PVC casing extended to about two feet above the surrounding ground elevation. A steel protective casing with lock will be installed around each PVC casing.

- Well completion reports for the new wells, including information on the specific site geology, will also be submitted to NCDENR.

After the new wells are installed, the monitoring well network will be sampled on a semiannual schedule.

Table No. 1
Proposed Monitoring Network

Monitoring Point	Type of Sample	Location
MW-11	Groundwater	Upgradient
MW-12	Groundwater	Downgradient
MW-13	Groundwater	Downgradient
MW-14	Groundwater	Downgradient
SW-1 or SW-1A	Surface Water	Upstream/Background
SW-2	Surface Water	Downstream

3.0 SAMPLING GUIDANCE AND FIELD RECORDS

All sampling and analysis shall be in accordance with the guidance and methods contained in *North Carolina Administrative Code T10.10G.0601-.0602;* North Carolina Solid Waste Section Guidelines for Groundwater, Soil, and Surface Water Sampling, 2008 (made part of this plan by reference).

Personnel involved in collection of groundwater samples shall keep an up-to-date field notebook which contains the following information:

- Identification of well
- Well depth
- Static water level and measurement technique
- Presence of immiscible layer and detection method
- Well purging procedure and equipment
- Sample withdrawal procedure and equipment
- Date and time of sample collection
- Well sampling sequence
- Types of containers used and sample identification numbers
- Preservatives used
- Parameters requested for analysis
- Field analysis data
- Sample distribution and transport
- Field observations on sampling event
- Name of collector

4.0. WATER LEVEL & DEPTH MEASUREMENT PROCEDURES

4.1. Scope

The procedure described below outlines the method of obtaining water level measurements in the monitoring wells. The preferred method for measurements includes the use of a conducting probe for water level and a weighted tape for the well depth.

4.2. Summary of Method

The electronic water level indicator is an instrument with a conducting probe attached to a calibrated tape. The probe is lowered carefully into the well casing. When the probe contacts the water a circuit is completed activating a light, a buzzer or a meter. The depth to water is determined by reading the appropriate increment on the tape. <u>Note: groundwater with dilute ionic content may not conduct enough current between electrodes at the normal setting. Instruments with adjustable sensitivity are preferred.</u>

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4.3. Procedures

1. Unlock and open well. Note the condition of the well and the protective casing. Don clean gloves.
2. Record well number, date, time, weather conditions, and any other well specific information.
3. Locate reference mark at top of casing.
4. If reference mark is not present on well casing, sampler should place a permanent mark on the casing. Note: the new mark will have to be surveyed to accurately determine its elevation.
5. Clean the probe on the electronic water level indicator. Check the battery and the light, buzzer or meter.
6. Lower the probe into the well making sure the tape on the probe does not become tangled or unnecessarily scrapes the sides of the well casing.
7. When the instrument indicates that the probe has contacted water, the sampler should stop lowering the probe.
8. Pull the probe up until the contact is broken.
9. Slowly lower the probe again stopping the instant the instrument indicates that the probe has contacted water.
10. Hold the calibrated tape to the side of the casing where the reference mark is located.
11. Mark the tape with thumb where it touches the reference mark.
12. Use a measuring device to determine the distance from the last mark on the tape to the spot indicated by the thumb. The distance indicated is the depth from the reference mark to the water level.
13. Record the measurement to the nearest 0.01 ft. as the "depth to water" in the field log book.
14. Repeat steps 6 - 13 three times for consistency.
15. Subtract the distance from the reference mark to the water level from the elevation of the reference mark to determine the elevation of the groundwater.
16. After each measurement, rinse the probe with deionized water to avoid possible cross contamination.

The depth of each monitoring well shall be determined each time a sampling event is conducted. The following procedures shall be used to determine the total well depth:

1. Lower a weighted measuring tape until it strikes bottom.
2. Measure and record the distance from the well bottom to the top of the well casing, recording the reading to the nearest 0.01 ft.
3. After each measurement rinse the weighted tape with deionized water to avoid possible cross contamination.

All procedures should be initiated with the upgradient or background well. Any departure from the procedures itemized above shall be documented in the field log book.

5.0. WELL PURGING PROCEDURE

5.1. Scope and Application

The procedure covers the purging of water from a well prior to sampling so that the sample is representative of the formation groundwater. The device used (bailer or pump) depends upon aquifer properties, individual well construction and data quality objectives.

5.2. Summary of Method

Well construction information is gathered prior to beginning purging. Water level is measured to calculate the volume of water present in the well. Purging is completed using a calculated number of volumes and/or field measurements to determine the end point.

5.3. Comments

Prior to sampling, each well shall be purged of all standing water. Each well shall either be pumped to dryness or at least three (3) well volumes of water removed.

Rate of purging should be regulated to minimize agitation of the ground water. If using a bailer to purge the well, lower and raise it slowly so as not to agitate the water in the well.

5.4. Procedures

1. Obtain the following information about well.
   - Well location
   - Diameter(s) of well
   - Depth of well
   - Screen interval(s)
2. Determine method to be used to purge well (i.e., pump or bailer).
3. Calibrate instruments according to manufacturer's instrument calibration and maintenance manual, if applicable.
4. Locate well and record well number, site, date and well condition in log book.
5. Unlock and open well after placing plastic sheeting on ground. Don rubber gloves.
6. Use know well depth information to determine the height of water column in well. Subtract distance to water level from depth of well to get the length of water column. Record all information in field log book.
   Depth of well - distance to water level = length of water column
7. Measure initial pH/specific conductance/temperature to evaluate water quality.
8. Purge well of required volumes after calculating volume of water in well.
   a. The formula for calculating the volume in gallons of water in the well casing or sections of telescoping well casing is as follows:

$$(\pi r^2 h)\ 7.481 = \text{gallons; where } \pi = 3.142$$

r = radius of the well pipe in feet

h = linear feet of water in well

7.481 = gallons per cubic foot of water

b. Calculation of the volume of water in typical well casing may be done as follows:
   1) 2" dia. well:
      0.1632 gal/ft. x ____ (linear ft. of water) = gal.
   2) 4" dia. well:
      0.6528 gal/ft. x ____ (linear ft. of water) = gal.
   3) 6" dia. well:
      1.4688 gal/ft. x ____ (linear ft. of water) = gal.

9. The well purging end point will be when 3 volumes have been removed from the well.
   a. Purge one well volume, and then begin measuring field parameters once during each well volume.
   b. Purge a total of at least 3 well volumes.
10. Purge 3 well volumes or to dryness only if sufficient water is not present to yield required purge volumes.
11. Record all purge times and rates of well evacuation in field log book.
12. When all necessary procedures are complete lock well, clean area and dispose of refuse.

6.0. SAMPLE COLLECTION PROCEDURES

All monitoring wells shall be sampled in accordance with the methods of EPA/SW-846, latest edition, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods". Samples shall be collected by the facility or their agents under the supervision of the Company's Environmental Supervisor.

6.1. Sampling with a Bailer (To be used only as a backup to sampling pump)

6.1.1. *Scope and Application*

This procedure describes the use of a bailer (hollow, cylindrical tube) for collecting groundwater samples. Groundwater samples may be used to obtain physical, chemical, or radiological data.

6.1.2. *Summary of Method*

A bailer is lowered by cord into the groundwater where it fills. The bailer is withdrawn, and its contents are drained into the appropriate containers.

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6.1.3. *Comments*

1. Only bottom loading stainless steel or Teflon bailers will be used. PVC may be permitted depending on parameters.
2. Bailers are economical and convenient enough that a separate bailer may be dedicated to each well to minimize cross contamination.
3. Only new, clean cord will be used.
4. A reel upon which the cord may be wound is helpful in lowering and raising the bailer. It also reduces chance of contamination.
5. Bailers constructed with adhesive joints may not be used.

6.1.4. *Procedures*

1. Record sampling station number, sample I.D., date, time, weather conditions, and any other well specific, pertinent information (i.e., water level, presence of product in log book).
2. Place plastic sheeting around well and work area.
3. Unlock and remove well cap.
4. Collect water level measurements by method outlined in Part A of the S and A Plan and record in log book. Remove clean bailer from protective covering attach cord allowing enough length for bailer to reach bottom of well.
5. Lower bailer slowly to the interval from which the sample is to be collected.
6. Allow bailer to fill with a minimum of surface disturbance in order to prevent sample water aeration.
7. Raise bailer to surface, feeding cord into container, reel or onto clean plastic sheeting.
8. Do not allow bailer cord to contact ground.
9. Remove the cap from the sample bottle, and tilt the bottle slightly.
10. Pour the sample slowly down the inside of the sample bottle. Avoid splashing of the sample. Assure that any suspended matter in the sample is transferred quantitatively to the sample bottle. Properly dispose of all excess water collected in bailer.
11. Leave adequate air space in the bottle to allow for expansion, except for VOA flasks.
12. Label the bottle carefully, and clearly. Enter all information accurately, and check to be sure it is legible.
13. Samples will be placed in containers defined according to the needs, and then, when appropriate, packed with ice in coolers as soon as practical. Packaging, labeling, and preparation for shipment procedures will follow procedures as specified in the Sampling and Analysis Plan.
14. Complete field log book and chain-of-custody forms in accordance with the S and A Plan.
15. Replace bailer is dedicated, replace well cap and lock.

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6.2. Sampling with an Electric Powered Centrifugal Pump

6.2.1. *Scope and Application*

This procedure discusses collection of groundwater samples using a single stage, centrifugal sampling pump specifically designed for environmental groundwater sampling.

6.2.2. *Summary of Method*

An electric centrifugal pump can be either dedicated to a well or cleaned/decontaminated before use. New Tygon tubing is attached to the pump. The pump is lowered into the well to a depth just above the screened interval.

6.2.3. *Comments*

If the centrifugal pump speed can be varied to reduce the flow to a "micro purge" rate, the pump can be used to collect samples for volatile organic analysis or total organic halogen analysis (TOX). If outgasing is of concern, this method may not be appropriate.

6.2.4. *Procedures*

1. Locate well and record number, site, date, and well condition in field log book.
2. Use plastic sheeting as necessary to prevent equipment from coming in contact with potentially contaminated surfaces.
3. Unlock and open well.
4. Collect water level measurements by method outlined in Part A of the S and A Plan and record in log book.
5. Lower pump in well to desired level, if pump is not dedicated.
6. Check control box for proper connections.
7. When a pump is used for purging, measure the amount of water discharged with a container of known volume, if capacity of pumped well is unknown, and calculate purge time for the required purge volume. Refer to the S and A Plan for well purging.
8. Obtain and record required measurements of the well water, (i.e., pH, specific conductance and temperature, and other parameters that may be specified in the Sampling and Analysis Plan).
9. Remove the cap from the sample bottle, and tilt the bottle slightly.
10. Pour the sample slowly down the inside of the sample bottle. Avoid splashing of the sample. Assure that any suspended matter in the sample is transferred quantitatively to the sample bottle.
11. Leave adequate air space in the bottle to allow for expansion. The exceptions to this statement are VOA vials, which should be collected by bailer, and are filled to overflowing and capped.
12. Label the bottle carefully and clearly. Enter all information accurately, and check to be sure it is legible.
13. Samples will be placed in containers defined according to the needs, and then, when appropriate, packed with ice in coolers as soon as practical. Packaging,

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labeling, and preparation in the S and A Plan.

14. Complete field log book and chain-of-custody forms in accordance with the S and A Plan.
15. If not dedicated, remove pump, close well cap and lock.

6.3. Sampling with a Bladder Pump

6.3.1. *Scope and Application*

This procedure discusses collection of groundwater samples using the bladder pump. The water samples may be used to obtain physical, chemical, or radiological data.

6.3.2. *Summary of Method*

A bladder pump is either dedicated to a well, or cleaned before use. The pump is placed in the well prior to sample collection. A compressed air source forces air through a control box which regulated timed intervals of air discharged into, and air escapes from, the bladder pump, along with air intake pressure. The bladder expands and contracts with air intake and escape, and thereby forces water to the head of the well where it is collected.

6.3.3. *Comments*

Because there is little aeration or agitation of the water, the bladder pump can be used to collect samples for volatile organic analysis.

6.3.4. *Procedures*

1. Locate well and record well number, site, date, and well condition in log book.
2. Use plastic sheeting as necessary to prevent equipment from coming in contact with potentially contaminated surfaces. Don rubber gloves.
3. Unlock and open well.
4. Collect water level measurements by method outlined in S and A Plan, and record in log book.
5. Attach air lines, samples lines and lifting lines to pump. Lifting lines should bear the weight of the pump with air and sample lines attached to lifting lines approximately every 10 feet with appropriate inert devices.
6. Lower pump in well to desired level, if pump is not dedicated.
7. Connect air lines from regulated compressed gas source to control box.
8. Connect battery, if required.
9. Start air flow.
10. Adjust flow rate with throttle knob found on control box.
11. To control discharge and refill cycle rate of the bladder, use the discharge and refill control knobs located on control box.
12. Equal length discharge and refill cycles are generally desirable, but individual well conditions may dictate otherwise.
13. When a bladder pump is used for purging, measure the amount of water discharged

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with a container of known volume, and calculate purge time for the required purge volume.

14. Obtain and record required measurements of the well water, (i.e., specific conductance, temperature and other measurements as require by the Sampling and Analysis Plan).
15. Remove the cap from the sample bottle, and tilt the bottle slightly.
16. Pour the sample slowly down the inside of the sample bottle. Avoid splashing the sample.
17. Leave adequate air space in the bottle to allow for expansion, except for VOA vials which are filled to overflowing and capped.
18. Label the bottle carefully and clearly. Enter all information in the log book accurately, and check to be sure it is legible.
19. Samples will be placed in containers defined according to the needs, and then, when appropriate, packed with ice in coolers as soon as practical. Packaging, labeling, and preparation for the shipment procedures will follow procedures as specified in the S and A Plan.
20. Complete field log book and chain-of-custody forms in accordance with The S and A Plan.
21. If pump is not dedicated, remove from well.
22. Replace well cap and lock.

7.0. FIELD MEASUREMENT PROCEDURES

7.1. Temperature

7.1.1. *Scope and Application*

This procedure is applicable to ground, surface, and saline waters.

7.1.2. *Summary of Method*

Temperature measurements may be made with any calibrated high quality mercury-filled thermometer or thermometer with analog or digital readout device.

7.1.3 *Comments*

For field operations using a glass thermometer, the thermometer will be transported in a protective case to prevent breakage. Thermometers of thermometer used with this procedure require calibration with a certified NBS thermometer.

7.1.4 *Procedure*

1. Use only mercury-filled thermometer or thermistor that is in calibration.
2. Inspect thermometer before each field trip to ensure that there are neither cracks in the glass, nor air spaces or bubbles in the mercury.
3. Allow thermometer or thermistor enough time to equilibrate to outside temperature when removed from a field vehicle.

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4. Insert thermometer or thermistor in-situ when possible, or in a grab sample. Swirl the thermometer or thermistor in the sample, and take the temperature reading when the mercury column or digital readout stabilizes; record temperature in field log book to the nearest 0.5°C or 1.0 °C, depending on need.

7.1.5. *Control of Deviations*

When feasible, any departure from specific requirements will be justified and authorized prior to deviating from the requirements. Deviations shall be sufficiently documented to allow repetition of the activity as actually performed.

7.1.6. *Calibration*

Each temperature measurement device will be initially calibrated at three temperatures covering the range of the device against a National Bureau of Standards (NBS) certified thermometer, and then cross-checked against a calibrated NBS certified thermometer at least semiannually.

7.2. pH (Hydrogen Ion Concentration)

7.2.1. *Scope and Application*

This procedure is applicable to ground, surface, and saline waters.

7.2.2. *Summary of Method*

The pH of a sample is determined electrometically using either a glass electrode in combination with a reference potential, or a combination electrode and a pH meter.

7.2.3. *Comments*

Coatings of oily material or particulate matter can impair electrode response. Remove these coatings by gentle wiping with a clean tissue followed by a distilled water rinse. Temperature effects on the electrometric measurement of pH are controlled by using instruments having temperature compensation or by calibrating the electrode meter system at the temperature of the sample.

7.2.4. *Procedure*

1. Prior to field activity check meter for mechanical and electrical failures, weak batteries, and cracked or fouled electrodes. Check pH recorders for recording and time scale accuracy.
2. Following instructions provided with each type of meter, test the meter against standard buffer solutions before using. Thereafter, the meter can be checked periodically against two buffers that bracket the expected value of the sample. Use a fresh aliquot of buffer solution for each measurement. Multi-range pH paper may be used to determine expected value.
3. For pH meter without automatic temperature compensation, bring the sample and buffer to same temperature, if possible. If the sample temperature differs more than 20c from the buffer solutions, adjust for temperature difference.

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4. Thoroughly rinse the electrode with distilled water and remove excess water between immersion in each buffer solution and sample.
5. Immerse the electrode in-situ when possible. If it is necessary to measure pH on a portion of the sample swirl the electrode at a constant rate until the meter reading reaches equilibrium. The rate of stirring used should minimize the air transfer rate of the air-water interface of the sample.
6. Note and record sample pH to the nearest 0.1 pH unit; repeat measurement on successive volumes of sample or in-situ until values differ by no less than 0.1 pH unit. Two or three volumes are usually sufficient.
7. For samples of high ionic strength, condition electrodes after cleaning by dipping them into sample for one minute, immerse in fresh portion of the same sample, and read pH.
8. For dilute, poorly buffered solutions, equilibrate electrodes by immersing in three or four successive portions of sample. Take a fresh sample to measure pH.
9. Turn off meter at last reading.
10. Rinse electrodes thoroughly with distilled water and store in appropriate storage solution as described in operating instructions for the specific meter or electrode.
11. Record data in notebook, per S and A Plan, and complete Chain-of-Custody forms.

7.2.5. *Control of Deviations*

When feasible, any departure from specified requirements will be justified and authorized prior to deviating from the requirements. Deviations shall be sufficiently documented to allow repetition of the activity as actually performed.

8.0. PACKAGING ENVIRONMENTAL SAMPLES FOR TRANSPORTATION

8.1. Scope and Application

This section describes the minimum procedure required to properly package containers for environmental samples to assure safe transport and to prevent degradation of sample quality. It outlines the general requirements to be followed for samples collected in the course of field investigations and monitoring activities. It applies to environmental samples as defined in Title 40 of the Code of Federal Regulations, Part 261.4, Paragraph (d); and Title 10, Part 71, Subpart B.

8.2. Summary of Method

Individual sample containers will be checked against accompanying chain-of-custody forms and analytical request forms prior to signing for receipt of the samples. Samples will be placed in strong exterior shipping packages and surrounded with compatible cushioning/absorbent material if necessary. The shipping package will be labeled and marked as per DOT regulations and restrictions of the carrier or receiver.

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8.3. Comments

The sampling crew should contact carriers and receivers prior to packaging to ascertain any specific restrictions, such as weight limits, delivery and pick-up schedules, receiving hours, or sample disposal terms.

9.0. QA/AC PROCEDURES

For each groundwater monitoring event one (1) Trip Blank and one (1) Equipment Blank will be analyzed for all the required parameters. If, for some reason, sampling equipment is heavily contaminated during the monitoring event and must be decontaminated in the field, a separate Equipment Blank will be prepared and analyzed.

10.0. SAMPLE ANALYSIS

10.1. Laboratory Certification

All analysis of the groundwater samples will be performed by a laboratory certified by the State of North Carolina. The laboratory to be used for the initial sampling event will be Test America's laboratory located in Nashville, Tennessee. The NC certification number for this laboratory is 387.

For most of the analytical parameters to be measured, there is usually more than one analytical method that may be applied from those approved by the regulatory agencies. Selecting the appropriate method involves assessing the characteristics of each sample, the intended use of the data obtained from the analysis, and the limitations imposed by the laboratory facility.

To select the most appropriate method for analysis, the following factors should be considered:

1. Physical state of the sample
2. Anticipated concentration of analysis
3. Required detection limit
4. Data quality objectives (DQO)
5. Regulatory requirements

10.2. Required Parameters for Analysis

Total Metals	*EPA Method Number*
Antimony	SW-846-6010B
Arsenic	SW-846-6010B
Beryllium	SW-846-6010B

Barium	SW-846-6010B
Cadmium	SW-846-6010B
Chromium	SW-846-6010B
Cobalt	SW-846-6010B
Copper	SW-846-6010B
Lead	SW-846-6010B
Nickel	SW-846-6010B
Selenium	SW-846-6010B
Silver	SW-846-6010B
Thallium	SW-846-6010B
Vanadium	SW-846-6010B
Zinc	SW-846-6010B

Organics

Acetone	SW-846-8260B
Acrylonitrile	SW-846-8260B
Benzene	SW-846-8260B
Bromochloromethane	SW-846-8260B
Bromdichloromathane	SW-846-8260B
Bromoform	SW-846-8260B
Carbon Disulfide	SW-846-8260B
Carbon tetrachloride	SW-846-8260B
Chlorobenzene	SW-846-8260B
Chloroethane	SW-846-8260B
Chloroform	SW-846-8260B
Dibromochoromethane	SW-846-8260B
1,2-Dibromoethane	SW-846-8260B
1,2-Dichlorobenzene	SW-846-8260B
1,4-Dichlorobenzene	SW-846-8260B
trans-1,4-Dichloro-2-butene	SW-846-8260B
1,1-Dichloroethane	SW-846-8260B
1,2-Dichloroethane	SW-846-8260B
1,1-Dichloroethylene	SW-846-8260B
cis-1,2-Dichloroethylene	SW-846-8260B
trans-1,2-Dichloroethylene	SW-846-8260B
1,2-Dichloropropane	SW-846-8260B
cis-1,3-Dichloropropene	SW-846-8260B
trans-1,3-Dichloropropene	SW-846-8260B
Ethylbenzene	SW-846-8260B
Methyl butyl ketone	SW-846-8260B
Methyl bromide	SW-846-8260B
Methyl chloride	SW-846-8260B
Methylene bromide	SW-846-8260B
Methylene chloride	SW-846-8260B

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Methyl ethyl ketone	SW-846-8260B
Methyl iodide	SW-846-8260B
Methyl isobutyl ketone	SW-846-8260B
Styrene	SW-846-8260B
1,1,1,2-Tetrachloroethane	SW-846-8260B
1,1,2,2-Tetrachloroethane	SW-846-8260B
Tetrachloroethylene	SW-846-8260B
Toluene	SW-846-8260B
1,1,1-Trichloethane	SW-846-8260B
1,1,2-Trichloethane	SW-846-8260B
Trichlorofluoromethane	SW-846-8260B
1,2,3-Trichloropropane	SW-846-8260B
Vinyl acetate	SW-846-8260B
Vinyl chloride	SW-846-8260B
Xylenes	SW-846-8260B

11.0 MONITORING REPORT

For each monitoring event a monitoring report will be prepared for submission to the NCDENR. Each report will include the following:

- A narrative discussing the monitoring event and noting any deviations from the plan or any abnormal situations.
- Analytical data will be presented in a spreadsheet tabulation using an EDD template.
- Fields sheets for each monitoring location will be provided.
- A potentiometric surface map showing the location of the monitoring wells and the surface water sampling points.
- Copies of the analytical reports from the laboratory.

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12.0 IMPLEMENTATION SCHEDULE

The following implementation schedule is proposed for the OmniSource Southeast facility in Kernersville:

1. Within sixty (60) days of approval of this Plan, any existing monitoring wells on the site will be abandoned and the new wells proposed in this Plan will be installed.

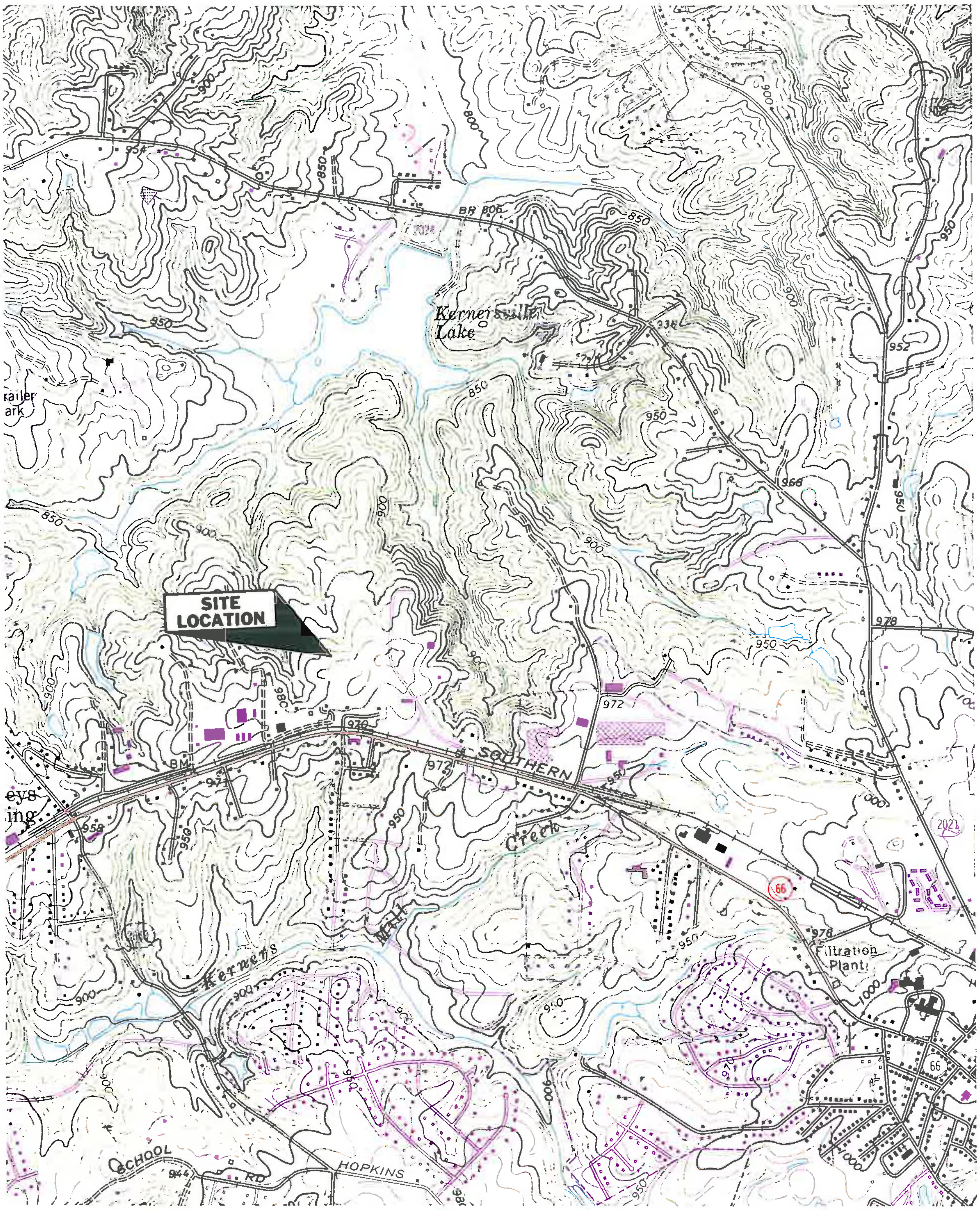
2. Within sixty (60) days of approval of this Plan, two surface water sampling locations will be developed included improving access to these locations.

3. Within thirty (30) days of the completion of the new monitoring wells, the first monitoring event will be conducted.

4. Within sixty (60) days of the monitoring event, a complete report will be submitted to NCDENR.

5. Subsequent monitoring of the network will be conducted on a semiannual basis.

EXHIBITS



W. Z. BAUMGARTNER & ASSOCIATES, INC.

ENVIRONMENTAL ENGINEERS AND CONSULTANTS

310 WILLIAMSON SQUARE (37064)
P. O. BOX 680369
FRANKLIN, TENNESSEE 37068-0369
615-595-0025

SITE LOCATION MAP

ATLANTIC SCRAP AND PROCESSING, LLC

KERNERSVILLE, NORTH, CAROLINA

N

USGS MAP(S)
KERNERSVILLE, NORTH CAROLINA
BELEW, NORTH CAROLINA

LAT 36° 08' 18" N
LONG. 80° 06' 08" W
Scale: 1"=2000'

WZB

NO.	REVISIONS	DATE	ENGR

BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

W.Z. BAUMGARTNER & ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS & CONSULTANTS
1113 MURFREESBORO ROAD
SUITE 310 WILLIAMSON SQUARE
FRANKLIN, TENNESSEE
615-595-0025

SEAL:

DRAWN BY: CLG
CHECKED BY: MET
ENGINEER: WZB
DATE: 12/8/2011

SITE MAP

OMNISOURCE SOUTHEAST
KERNERSVILLE, NORTH CAROLINA

SCALE: NTS
PROJECT NO.: 89109
EXHIBIT NO: 2

OMNISOURCE SOUTHEAST
KERNERSVILLE, NORTH CAROLINA
DATE OF PHOTOGRAPH: 2010

APPENDIX A

EXCERTS FROM LANDFILL EVALUATION - 1997

WZB

LANDFILL EVALUATION

UNITED METAL RECYCLERS LANDFILL
KERNERSVILLE, NORTH CAROLINA

NOVEMBER 1997

NORTH CAROLINA PROFESSIONAL SEAL 17882 ENGINEER W. Z. BAUMGARTNER, JR.

11/26/97

W. Z. BAUMGARTNER & ASSOCIATES, INC.
Environmental Consultants
P.O. Box 786
Brentwood, TN 37024-0786

97054

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GEOLOGIST CERTIFICATION

This is to certify that the geohydrologic information in the accompanying report on the United Metal Recyclers Landfill, Kernersville, North Carolina, was done by me or under my direct supervision. This includes the geohydrologic field work and interpretation including the location, logging and installation of all piezometers.

Bruce D. Miller

Bruce D. Miller
TN4106
NC Temp.

Nov 26, 1997

Date

WZB

An Erosion and Sediment Control Plan was developed for this facility in August 1995, and was approved by the North Carolina Department of Environment, Health and Natural Resources (DEHNR) on August 24, 1995. This consisted of a series of sediment traps constructed in the wet weather conveyance which drains to a marshy area.

IV. WASTE CHARACTERISTICS

Waste landfilled at this facility is generated from United Metal Recyclers operations adjacent to the landfill. The most predominate waste is shredder residue, which consists primarily of non-metallic solid material including plastic, broken glass, rubber, foam rubber, soil and fabric. Shredder residue is an unconsolidated non-homogenous solid with a medium to dark brown color. Freshly generated shredder residue may have a mild, musty odor. Approximately 150 tons/day of waste is landfilled at this facility. The waste has been sampled and characterized on a periodic basis. The waste analysis demonstrates that it is not a hazardous waste under RCRA. Appendix B presents sampling data of the shredder residue which is being landfilled.

V. HYDROGEOLOGIC STUDY

A. INTRODUCTION

The hydrogeologic study addresses the geology, geochemistry, and hydrogeology of the Kernersville, North Carolina United Metals Recyclers site. Historical data, recent field data, statistical analyses and finite difference method have been utilized to determine the point of compliance and draw conclusions with respect to elevated levels of iron and manganese found in the groundwater at this site.

Government agencies and private consulting firms have been responsible for historical

WZB

background data. This background data has been correlated with recent field work and was prepared by a registered geologist in the State of North Carolina under the supervision of an environmental engineer registered in the State of North Carolina. The primary focus of the hydrogeologic report is to:

- Summarize historical data
- Present the effect of leachate on the groundwater with and without a landfill cap
- Make groundwater flow and groundwater chemistry predictions based on field data, lab results, and numerical modeling (FLOWPATH)

Phase I took place in June of 1997 and encompassed the following: site inspection, modeling to determine the most favorable location to place piezometers, and gathering of historical and academic data relative to naturally occurring iron and manganese.

Phase II took place over August and September of 1997 and encompassed the drilling of 4 new piezometers, a shelby tube sample from one of the new borings, a survey of all monitoring well and piezometer elevations, a finite difference model for prediction of groundwater flow, and the gathering of all data for this report.

B. EARLIER HYDROGEOLOGICAL STUDIES

S&ME, Inc. of Greensboro, North Carolina produced a report based on their soil testing at this site in January 1992. Appendix C contains soils boring logs and a typical well construction diagram from that study. Other references include USGS maps, US Dept. Of Agriculture soils studies, state and county government files relating to landfill applications, and conversations with Forsyth County health officials. Appendix E presents results from past monitoring events of the four existing monitoring wells.

C. PIEZOMETERS

Field investigations were conducted between June 25, 1997 and August 15, 1997. Four piezometers were installed in August 1997. Each piezometer consisted of 1.25 inch or 2 inch diameter flush threaded schedule 40 PVC pipe installed at a depth of roughly 30 feet below the ground. The lower 10 feet of pipe was screened. A 2 foot sand pack was placed above the screen with bentonite seal above the sand pack. The annular space was filled with cuttings and mounded to direct runoff away from the piezometer. The piezometers are planned to be temporary and will be abandoned after approval of the Phase II hydrogeological report. The logs for the piezometers is presented in Appendix D.

D. SOILS

Soils encountered during piezometer installation were similar to those encountered in other locations of the property by S&ME. They are described as 1) slightly sandy clayey silts to sandy silts and 2) medium to fine sands and silty sands. Since the most recent drilling was done at lower elevations, as compared to the soils investigation performed by SM&E, a much higher clay content was present. This clay was reddish, wet, with a high plasticity and contained not as much of the weathered rock fragments found in the silty sand. The silty sand is more derivative of granite, gneiss and schist.

Sandy soils were found to be layered and contained lenses of varying permeability. Clay layers tended to be thicker and more homogeneous.

Some shredder residue was encountered in the borings for piezometers MW-5 and MW-6 to a depth of 12 feet. Soil, up to 6 feet, covered this shredder residue. This shredder residue is suspected to be the result of past erosion prior to slope stabilization.

Soils in the two boreholes MW-7 (approximately 300 feet north of the landfill) and MW-

8 (approximately 75 feet southwest of MW-2) consisted of clay and silty clay and emitted no hydrocarbon odor at any depth. Upon visual inspection, the soil was free of landfill debris. Upon analysis by a contracted laboratory, groundwater in MW-7 was determined to have concentrations below MCL's for metals.

A Shelby tube sample was taken at MW-6. This contained a typical section of saturated silty sand found throughout the property which is a representation of the main aquifer. Lab analysis of this soil showed the average hydraulic conductivity to be 6.9×10^{-5} cm/sec. This analysis is presented in Appendix F.

E. WATER LEVELS

Water levels were taken several hours after the piezometers were installed and again five days later. Since very little change occurred between the two readings, it was assumed that levels had stabilized.

F. SURVEY

Top of casing elevations of all new piezometers were surveyed. Older surveys of previous monitoring wells were used as benchmarks for new piezometer elevations. All water levels were used in the numerical model to calibrate constant head boundaries for the entire site.

G. FIELD OBSERVATIONS

There is some amount of erosion between MW-2 and MW-3 on the east slope of the landfill. Seepage was observed at several points on the east slope. Seeps were also

WZB

observed north of the landfill.

The water level in the marshy area varied by as much as 1-1/2 feet between June 25, 1997 and August 6, 1997; however, water levels in the monitoring wells did not vary significantly over this time frame. This suggests semi-confined conditions below the marshy area. Since all piezometric levels above but nearby the marshy area were below the surface elevation it may be assumed that the aquifer is unconfined. All earlier hydrogeological reports show the piezometric surface to be dependent on localized topography and permeability. Soil conditions in a marshy area tend to be more impervious when dry. Therefore, evaporation would outpace infiltration in drier periods making a large difference between the permeability of a wetting surface or a drying surface in the clay layers. This would make runoff to the marshy area dependent more on long term climate effects rather than short bursts of rainfall. There exists a non-linearity which is typical of unsaturated flow, but even more pronounced because this is a discharge area. The problem is compounded by the marshy area occupying such a large area of the site. Hence, infiltration and evaporation cannot be properly quantified in terms of diluting whatever contaminants may enter the subsurface flow regime but do play a major part.

H. GEOLOGY AND HYDROGEOLOGY

Forsyth County is located entirely within the Piedmont area of North Carolina. This region is characterized by gently rolling hills which formed by differential erosion of rocks due to local variations in resistance to weathering. The site is located in the Milton Litho-Tectonic Belt, which is made up of metamorphic and igneous rocks. Metamorphic rocks consist of biotite gneiss and schist, potassic feldspar and garnet, interlayered with calc-silicate rocks, mica schist, and amphibolite. Igneous rocks are intrusive porphyritic granite.

Soils at the site are made up of three major soil types: the Cecil Series, Pacolet Series, and Wedowee-Louisburg Complex. All are well-drained weathering products of granite,

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gneiss, schist, and other acidic rocks. The soils below a thin layer of topsoil range from clayey silts to sand. Residuum thickness can be over 50 feet before reaching partially weathered rock of the same material. The soil in most places is inundated with mica flakes.

I. GEOCHEMISTRY

After researching county and state records, it is clear that manganese and iron present in groundwater supplies are primarily due to geological conditions and naturally occurring bacteria. In addition, anaerobic conditions in the sediment of the marshy area can lead to biological reduction of the iron and manganese in the soil, significantly increasing solubility. Borings upgradient of the Kernersville Sanitary Landfill showed much iron staining at depth. These borings also show manganese streaking in clayey silt and visible manganese in silty sand along with abundant manganese in the residuum between 7 and 23 feet depth.

The Vulcan Materials quarry lists local granite as 5% iron, 7% iron oxide, .1% manganese oxide, and 545 ppm manganese. The gneissic rocks were listed at 6% iron, 9.4% iron oxide, .2% manganese oxide, and 1050 ppm manganese. Both had high cation exchange coefficients when pulverized. This suggests a lot of mobility with manganese in a residuum where the parent material is gneiss and/or granite and the water is high in iron from bacteria. In other words, standing water in the marshy area (reducing conditions) entering this residuum can cause the iron to adhere to clay particles and cause manganese ions to go into solution from manganese oxide geologically present. This should show up as a less than equal ratio of total manganese to iron which differs from a test cell (discussed in the next section).

Studies at the Carolawn inactive waste site in the 1980s showed very high levels of manganese and iron in the sediment, surface and ground waters. This site is upgradient from the existing downgradient wells at the landfill.

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Manganese is a common replacement element for iron atoms in the crystal lattice structure of minerals. Manganese can also be found in minerals containing no iron. In locally occurring glaucophane schists and chlorite schists, manganese may replace up to 68% of iron. This occurs during the formation of these rocks and not as a by-product of weathering or environmental disturbances.

Chloritoid is found in low to medium grade Phyllite, quartzite, and mica and is a source of manganese. Spessartine is manganese garnet which is found in granite and felsic igneous rocks which are locally abundant. Lesser sources of manganese may include Piedmontite and Rhodonite.

J. TEST CELL CONSTRUCTION

In order to simulate leachate generation from samples of solid waste taken from the United Metal Recyclers facility, a laboratory scale test cell was used. The cell holds about one cubic foot of compacted waste between a sand underdrain and a sand cover. The lower portion of the cell contains a leachate collection chamber and a drain valve. Leachate may enter this chamber through a perforated plexiglass plate. Prior to the cell being filled, a sheet of non-woven geotextile filter fabric was placed on top of the perforated plate to prevent sand from plugging the holes. Sheets of the same geotextile fabric were placed above and below the waste to prevent the unwanted mixing of the sand and the waste.

The sand used in the cell, both above and below the waste, was a washed and graded silica sand manufactured for swimming pool filters. Six inches of sand was used below the waste to reduce the possibility of small waste particles being washed out of the waste zone into the leachate collection chamber. Twelve inches of sand were placed above the waste zone. The sand above the waste served two purposes. First, the weight of the sand provided some compaction to the waste as would be expected in the upper zone of a landfill close to the cover. Second, as liquid was added to the cell, the twelve inch thickness of sand helped

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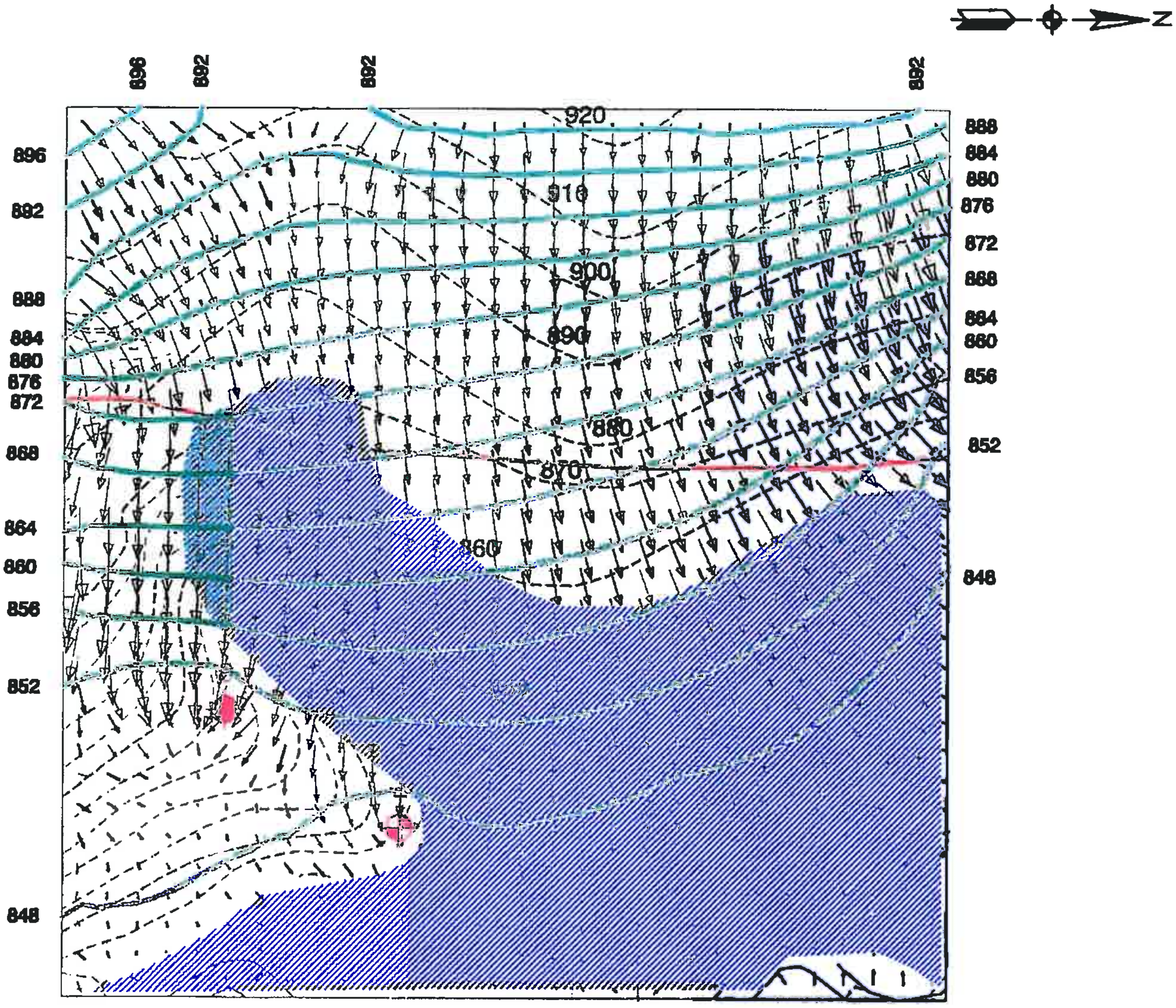


LEGEND

GROUNDSURFACE CONTOUR

GROUNDWATER CONTOUR

GROUNDWATER FLOW DIRECTION (SIZE INDICATES VELOCITY)

LANDFILL BOUNDARY

POTENTIAL SEEPAGE AND/OR SURFACE WATER

2 MONITORING WELL

8 PIEZOMETER

GRAPHIC SCALE

1 0 1 2

1"=50'

W.Z. Baumgartner & Associates, Inc.
Brentwood, Tennessee
615-373-1572
Fax: 615-370-9292

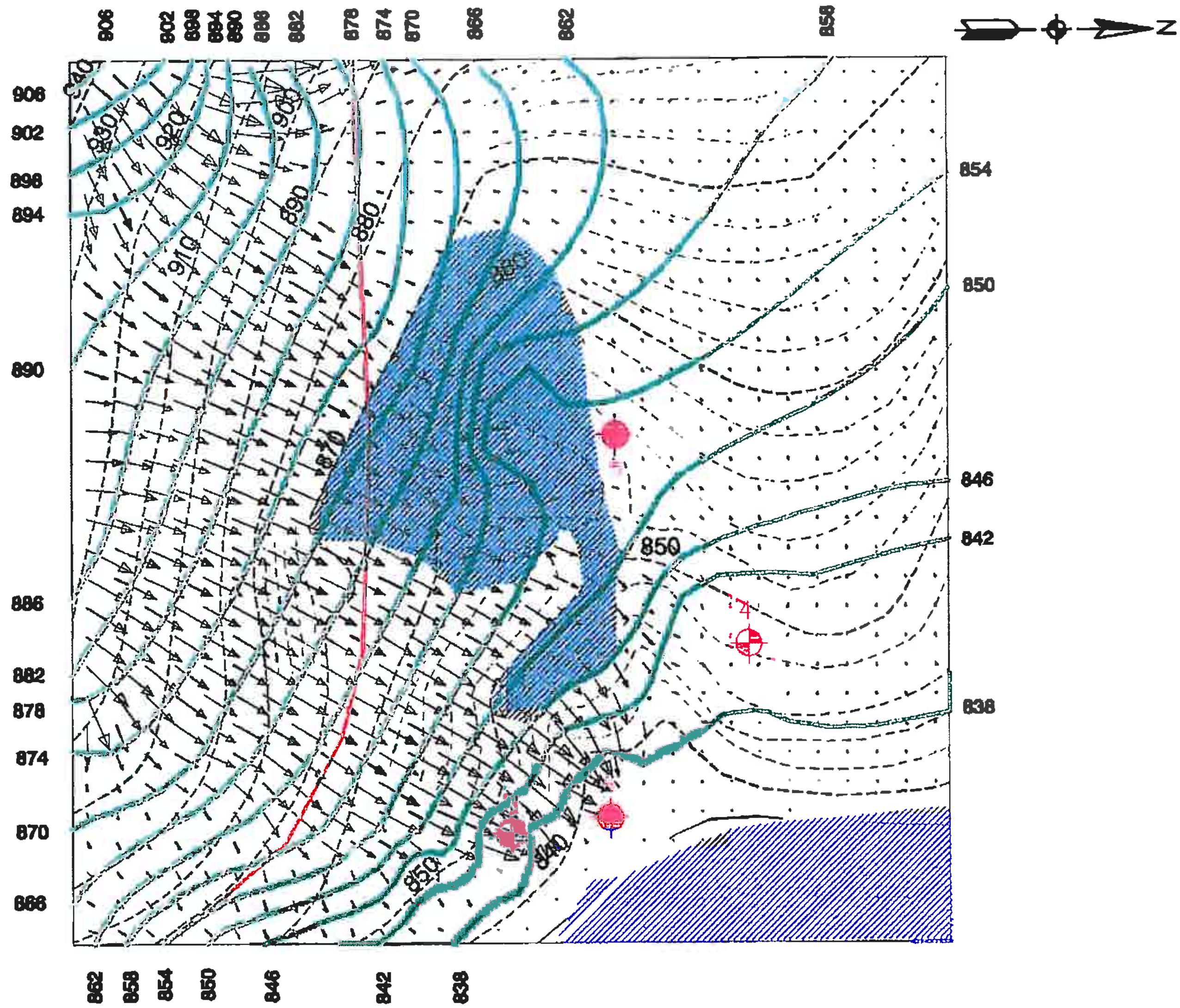
GROUNDWATER VELOCITY MAP 1

UNITED METAL RECYCLERS

KERNERSVILLE, NORTH CAROLINA

EXHIBIT

4



LEGEND

GROUNDSURFACE CONTOUR

GROUNDWATER CONTOUR

GROUNDWATER FLOW DIRECTION (SIZE INDICATES VELOCITY)

LANDFILL BOUNDARY

POTENTIAL SEEPAGE AND/OR SURFACE WATER

2 MONITORING WELL

8 PIEZOMETER

GRAPHIC SCALE

1 0 1 2

1"=50'

W.Z. Baumgartner & Associates, Inc.
Brentwood, Tennessee
615-373-1572
Fax: 615-370-9292

GROUNDWATER VELOCITY MAP 2

UNITED METAL RECYCLERS
KERNERSVILLE, NORTH CAROLINA

EXHIBIT 5

APPENDIX A

WELL LOGS OF WELLS INSTALLED IN 1990

WZB

STRATIGRAPHY LOG (OVERBURDEN)

SHEET NO. 1 OF 5

PROJECT NAME United Metals Recyclers
PROJECT NUMBER 89109
CLIENT Same
LOCATION Kernersville, NC

DRILLING CONTRACTOR Geotek
DRILLER Tony Langley
SURFACE ELEVATION
WEATHER (a.m.) Rainy, temp. High 60's
(p.m.) sunny, temp. High 70's

HOLE DESIGNATION MW#1
DATE STARTED 10-23-90
DATE COMPLETED 10-23-90
DRILLING METHOD Hollow Stem auger
SUPERVISOR Bob Powell

DEPTH OR ELEVATION (ft/m) FROM	AT	TO	SAMPLE #	SAMPLING METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	RECOVERED LENGTH	SAMPLE DESCRIPTION (COMPONENTS, COLOUR, MOISTURE, NATIVE/FILL)	NOTES (STRUCTURES, DRILLER'S COMMENTS, GEOLOGIC CLASSIFICATION)
0		2								Brown silty clay loam soil zone	
2		4								Red-orange (bright) silty clay zone	slightly plastic
4		5								same; becoming more orange	
5		7	1	split spoon	11	21	22	17	22"	same; less moist	
7		10								same; more red, silty, less moist, black streaks	visible quartz grains
10		12	2	split spoon	5	5	10	10	22"	white to tan sandy clay, large quartz frags.	Black & red streaks
12		15								red silty clay; slightly plastic	Black streaks
15		17	3	split spoon	11	10	9	17	20.5"	tan to orange silty to sandy clay	prominent qtz. grains
17		18								Brown to tan clay, less silty, plastic	
18		20								same; w/large quartz fragments	
20		25								tan to reddish silty clay; quartz rich	slightly plastic
25		30								same; more tan & silty	
30		35								same; w/quartz grains & pebbles, mica grains (black)	
35		40								same; less plastic	
40		45								same; more plastic, orange streaks	(root material)
										w/large quartz grains	
45		51								same; w/very large quartz frags.	

STRATIGRAPHY LOG (OVERBURDEN)

PROJECT NAME United Metals Recyclers
PROJECT NUMBER 89109
CLIENT Same
LOCATION Kernersville, NC

DRILLING CONTRACTOR Geotek
DRILLER Tony Langley
SURFACE ELEVATION
WEATHER (a.m.) sunny; temp. high 40's
(p.m.)

HOLE DESIGNATION Bh-6
DATE STARTED 10-23-90
DATE COMPLETED
DRILLING METHOD Hollow stem
SUPERVISOR Bob Powell

DEPTH OR ELEVATION (ft/m) FROM	AT	TO	SAMPLE #	SAMPLING METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	LENGTH RECOVERED	SAMPLE DESCRIPTION (COMPONENTS, COLOUR, MOISTURE, NATIVE/FILL)	NOTES (STRUCTURES, DRILLER'S COMMENTS, GEOLOGIC CLASSIFICATION)
0		23								shredder fluff material	
23		25								dark gray to black, viscous mud-like material	
25		40								shredder fluff material	
40		40.2'		shelby tube					4"	attemped shelby tube sample; unable to penetrate	
40.2'		42.0								shredder fluff material	
42.0		49.0								dark gray to black, mud-like material	
49.0		57.5								shredder fluff material	
57.5		62.5								dark gray to black, mud-like material	
62.5		64.0								Auger refusal; terminating borehole advance	

2/05/88

STRATIGRAPHY LOG (OVERBURDEN)

PROJECT NAME United Metals Recyclers
PROJECT NUMBER 89109
CLIENT Same
LOCATION Kernersville, NC

DRILLING CONTRACTOR Geotek
DRILLER Tony Langley
SURFACE ELEVATION
WEATHER (a.m.) Sunny, temp. high 30's
(p.m.)

HOLE DESIGNATION MW #3
DATE STARTED 10-26-90
DATE COMPLETED Same
DRILLING METHOD Hollow stem Auger
SUPERVISOR Bob Powell

DEPTH OR ELEVATION (ft/m) FROM	AT	TO	SAMPLE #	SAMPLING METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	LENGTH RECOVERED	SAMPLE DESCRIPTION (COMPONENTS, COLOUR, MOISTURE, NATIVE/FILL)	NOTES (STRUCTURES, DRILLER'S COMMENTS, GEOLOGIC CLASSIFICATION)
0		1.5								Red-orange clay w/mica grains	(very muddy)
1.5		2.5								dark brown silty soil w/qtz & mica grains	(becoming drier)
2.5		5.0								same; becoming more plastic	
5.0		7.0	1	split spoon	4	6	10	12	22"	light gray silty to very fine sandy clay w/ prominent quartz grains	plastic
7.0		10.0								tan silty clay w/large quartzite & gneiss frags.	(less plastic)
10.0		17.5								brownish-tan silty clay w/qtz & mica grains	(plastic)
17.5		22.5								same; more tan, very moist @ bottom	(very wet)
22.5		27.5								same; very saturated @ bottom	
27.5		29.5	2	Shelby tube					24"	T.D. of hole	

STRATIGRAPHY LOG (OVERBURDEN)

SHEET NO. 4 OF 5

PROJECT NAME United Metals Recyclers
PROJECT NUMBER 89109
CLIENT Same
LOCATION Kernersville, NC.

DRILLING CONTRACTOR Geotek
DRILLER Tony Langley
SURFACE ELEVATION
WEATHER (a.m.) clear, cold (low 30's)
(p.m.)

HOLE DESIGNATION MW #4
DATE STARTED 10-27-90
DATE COMPLETED
DRILLING METHOD Hollow Stem Auger
SUPERVISOR Bob Powell

DEPTH OR ELEVATION (ft/m) FROM	AT	TO	SAMPLE #	SAMPLING METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	LENGTH RECOVERED	SAMPLE DESCRIPTION (COMPONENTS, COLOUR, MOISTURE, NATIVE/FILL)	NOTES (STRUCTURES, DRILLER'S COMMENTS, GEOLOGIC CLASSIFICATION)
0		.5								Brown soil zone	
.5		2.5								tan silty clay w/qtz. grains	(somewhat plastic)
2.5		5.0								Light gray to tan silty clay w/qtz grains, mica grains, Large quartzite fragments	(Less plastic)
5.0		7.0	1	split spoon	5	8	7	9	22"	Light to dark gray silty to sandy clay	(root material)
7.0		12.5								same; became very moist @ 11.0'	
12.5		22.5								same; very wet @ 20.0'; darker w/depth	
22.5		24.5							1.3'	T.D. of well in weathered quartzite	

2/05/88

STRATIGRAPHY LOG (OVERBURDEN)

SHEET NO. 5 OF 5

PROJECT NAME United metal Recyclers
PROJECT NUMBER 89109
CLIENT Same
LOCATION Kernersville, NC

DRILLING CONTRACTOR Geotek
DRILLER Tony Cangley
SURFACE ELEVATION
WEATHER (a.m.)
(p.m.) sunny, temp high 50's

HOLE DESIGNATION MW #2
DATE STARTED 10-27-90
DATE COMPLETED
DRILLING METHOD Hollow Stem auger
SUPERVISOR Bob Powell

DEPTH OR ELEVATION (ft/m) FROM	AT	TO	SAMPLE #	SAMPLING METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	LENGTH RECOVERED	SAMPLE DESCRIPTION (COMPONENTS, COLOUR, MOISTURE, NATIVE/FILL)	NOTES (STRUCTURES, DRILLER'S COMMENTS, GEOLOGIC CLASSIFICATION)
0		1.0								Light grey to tan silty clay	
1.0		4.0								tan sandy clay w/large qtz. fragments	(slightly moisT)
										3" thick zone of Quartzite	
4.0		5.0								same; some silt size particles	(moist)
5.0		7.0	1	split spoon	3	4	5	7		same; more moisT, less silty	
7.0		8.0								same	
8.0		15.0								same; more orange & moisT	
15.0		20.0								same; very wet zone @ 15.0'	
20.0		22.0	2	Shelby tube						same; very wet	

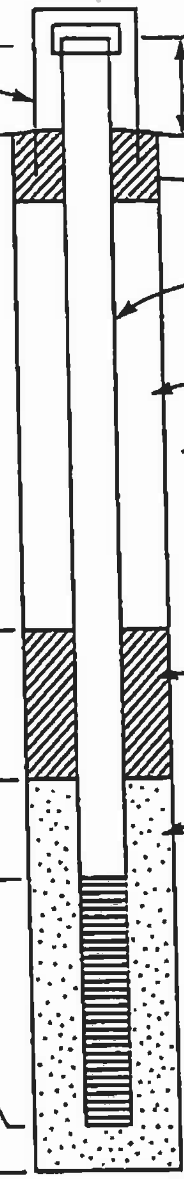
WELL INSTRUMENTATION LOG

PROJECT NAME: United Metals Recyclers
HOLE DESIGNATION: MW#1

PROJECT Nº: 89109
DATE COMPLETED: 10-25-90

CLIENT: Same
DRILLING METHOD: Hollow stem auger

LOCATION: Kernersville, NC
CRA SUPERVISOR: Bob Powell



CAP TYPE Pemco Pressure cap #257-2

PROTECTIVE CASING

GROUND SURFACE

STICK UP = 2.0 (ft)/m.

SURFACE SEAL TYPE Cement grout

WELL CASING

ANNULUS BACKFILL TYPE: Cement/bentonite grout

TOP OF SEAL* AT 33.83 (ft)/m

SEAL TYPE Bentonite

BOTTOM OF SEAL* AT 35.5 (ft)/m

PACK TYPE: (SAND) SIZE coarse
- GRAVEL
- NATURAL

TOP OF SCREEN* AT 37.0 (ft)/m

BOTTOM OF SCREEN* AT 47.0 (ft)/m

BOTTOM OF HOLE* AT 47.5 (ft)/m

*NOTE: ALL DIMENSIONS ARE BELOW GROUND SURFACE (BGS)

SCREEN TYPE: ☒ continuous slot ☐ perforated ☐ louvre ☐ other:

SCREEN MATERIAL: ☐ stainless steel ☒ plastic ☐ other:

SCREEN LENGTH: 10.0 (ft)/m SCREEN DIAMETER: 2.0 (in)/cm SCREEN SLOT SIZE: 0.01 in

WELL CASING MATERIAL: Sch 40 PVC WELL CASING DIAMETER: 2.0 (in)/cm

HOLE DIAMETER: 8"

DEVELOPMENT: METHOD: hand bailer DURATION: 35 bails to dry

WELL INSTRUMENTATION LOG

PROJECT NAME: United Metals Recyclers

PROJECT Nº: 89109

CLIENT: Same

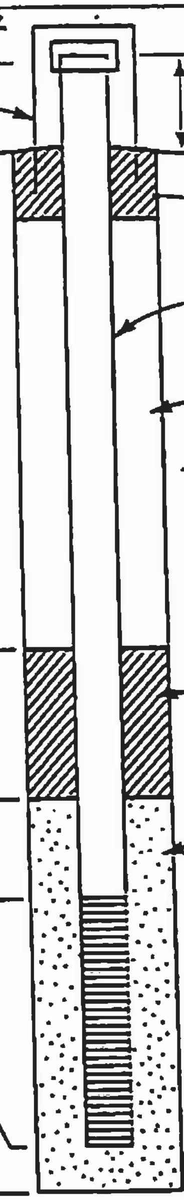
LOCATION: Kernersville, NC

HOLE DESIGNATION: MW #2

DATE COMPLETED: 10-27-90

DRILLING METHOD: Hollow stem auger

CRA SUPERVISOR: Bob Powell



CAP TYPE Pemco Pressure Cap #257-2

PROTECTIVE CASING

GROUND SURFACE

STICK UP = 2.5 ft./m.

SURFACE SEAL TYPE cement grout

WELL CASING

ANNULUS BACKFILL TYPE: cement/bentonite grout

TOP OF SEAL* AT 2.75 ft/m

SEAL TYPE Bentonite

BOTTOM OF SEAL* AT 3.75 ft/m

PACK TYPE: SAND, SIZE Coarse
- GRAVEL
- NATURAL

TOP OF SCREEN* AT 4.75 ft/m

BOTTOM OF SCREEN* AT 14.33 ft/m

BOTTOM OF HOLE* AT 14.75 ft/m

*NOTE: ALL DIMENSIONS ARE BELOW GROUND SURFACE (BGS)

SCREEN TYPE: ☒ continuous slot ☐ perforated ☐ louvre ☐ other:

SCREEN MATERIAL: ☐ stainless steel ☒ plastic ☐ other:

SCREEN LENGTH: 10 ft/m SCREEN DIAMETER: 2.0 in/cm SCREEN SLOT SIZE: 0.01 in

WELL CASING MATERIAL: Sch 40 PVC WELL CASING DIAMETER: 2.0 in/cm

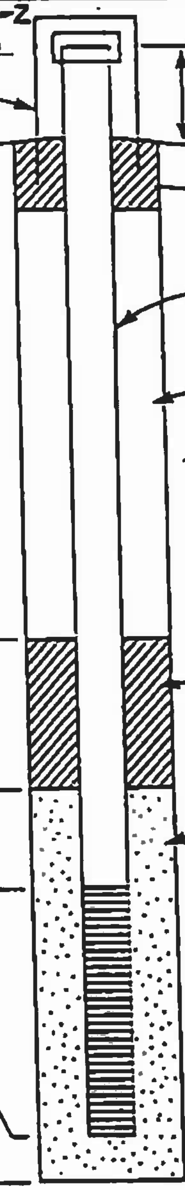
HOLE DIAMETER: 8"

DEVELOPMENT: METHOD: hand bailer DURATION:

WELL INSTRUMENTATION LOG

PROJECT NAME: United Metals Recyclers
PROJECT Nº: 89109
CLIENT: same
LOCATION: Kernersville, NC

HOLE DESIGNATION: MW #3
DATE COMPLETED: 10-26-90
DRILLING METHOD: Hollow stem auger
CRA SUPERVISOR: Bob Powell



CAP TYPE: Pemco Pressure Cap #257-2
PROTECTIVE CASING
GROUND SURFACE
STICK UP = 2.25 ft./m.
SURFACE SEAL TYPE: cement grout
WELL CASING
ANNULUS BACKFILL TYPE: cement/bentonite grout

TOP OF SEAL* AT 5.0 ft/m
SEAL TYPE: Bentonite
BOTTOM OF SEAL* AT 7.0 ft/m
PACK TYPE: - SAND, SIZE coarse
- GRAVEL
- NATURAL
TOP OF SCREEN* AT 9.0 ft/m
BOTTOM OF SCREEN* AT 19.0 ft/m
BOTTOM OF HOLE* AT 19.5 ft/m

*NOTE: ALL DIMENSIONS ARE BELOW GROUND SURFACE (BGS)

SCREEN TYPE: ☒ continuous slot ☐ perforated ☐ louvre ☐ other:

SCREEN MATERIAL: ☐ stainless steel ☒ plastic ☐ other:

SCREEN LENGTH: 10.0 ft/m SCREEN DIAMETER: 2.0 in/cm SCREEN SLOT SIZE: 0.01 in

WELL CASING MATERIAL: Sch 40 PVC WELL CASING DIAMETER: 2.0 in/cm

HOLE DIAMETER: 8.0"

DEVELOPMENT: METHOD: hand bailer DURATION:

WELL INSTRUMENTATION LOG

PROJECT NAME United Metals Recyclers

PROJECT Nº: 89109

CLIENT: Same

LOCATION: Kernersville, NC

HOLE DESIGNATION: MW#4

DATE COMPLETED: 10-27-90

DRILLING METHOD: Hollow stem auger

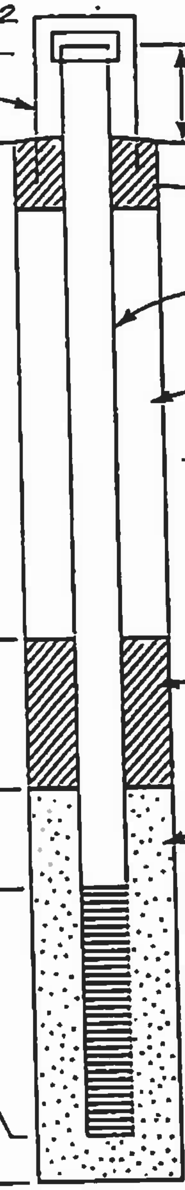
CRA SUPERVISOR: Bob Powell

CAP TYPE Pemco Pressure cap #257-2

PROTECTIVE CASING

GROUND SURFACE

STICK UP = 2.5 ft/m.



SURFACE SEAL TYPE Cement grout

WELL CASING

ANNULUS BACKFILL TYPE: cement/bentonite grout

TOP OF SEAL* AT 10.0 ft/m

SEAL TYPE Bentonite

BOTTOM OF SEAL* AT 11.0 ft/m

PACK TYPE: - SAND SIZE coarse
- GRAVEL
- NATURAL

TOP OF SCREEN* AT 12.0 ft/m

BOTTOM OF SCREEN* AT 22.0 ft/m

BOTTOM OF HOLE* AT 22.5 ft/m

*NOTE: ALL DIMENSIONS ARE BELOW GROUND SURFACE (BGS)

SCREEN TYPE: ☒ continuous slot ☐ perforated ☐ louvre ☐ other: ______

SCREEN MATERIAL: ☐ stainless steel ☒ plastic ☐ other: ______

SCREEN LENGTH: 10.0 ft/m SCREEN DIAMETER: 2.0 in/cm SCREEN SLOT SIZE: 0.01 in

WELL CASING MATERIAL: Sch 40 PVC WELL CASING DIAMETER: 2.0 in/cm

HOLE DIAMETER: 8"

DEVELOPMENT: METHOD: hand bailer DURATION: ______

S&ME

March 17, 1992

W.Z. Baumgartner and Associates, Inc.
P.O. Box 786
Brentwood, Tennessee 37024

Attention: Mr. Michael E. Tant, P.E.

Reference: Geologic and Hydrogeologic Study
United Metal Recyclers
S&ME Job No. GBW-B-050

Dear Mr. Tant:

This report presents the geologic and hydrogeologic information required for the permit application for the proposed United Metal Recyclers landfill. Enclosed are the maps, profiles, charts, and reports as they pertain to groundwater and geology to substantiate portions of the site application as required in Section .0504 "Application Requirements for Sanitary Landfills" of the North Carolina Solid Waste Management Rules as amended March, 1991. Also submitted is an evaluation of soils to be used as liner and cover materials. Preliminary recommendations concerning liner considerations are also included.

Data provided in this report was collected using an 8 hole test boring program, the locations of which were chosen upon consultation with your office and field verified by Mr. William Tucker of you office and Mr. Jim Buschur of S&ME.

If you should have any questions regarding the enclosed information, or if we may be of any further assistance to you, please feel free to contact us at your convenience.

Very truly yours,

S&ME, Inc.

Jim Buschur

Jim Buschur
Staff Scientist

NORTH CAROLINA PROFESSIONAL SEAL 9364 ENGINEER WALTER STRAND, III

Walter Strand III

Walter Strand III, P.E.
Senior Engineer

JB/WSIII/vr

S&ME, Inc. 135-C Montlieu Avenue, Greensboro, North Carolina 27419, (919) 855-7547, Fax (919) 855-8017
Mailing address: P.O. Box 18169, Greensboro, North Carolina 27419

Printed on Recycled Paper

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APPENDICES

I. INTRODUCTION

A geologic and hydrologic investigation of the proposed landfill area for auto fluff was conducted between January 28 and February 4, 1992. The new facility is to be located on approximately 30 acres adjacent to the existing auto fluff landfill owned by United Metal Recyclers of Kernersville, North Carolina. The information presented herein substantiates portions of the Site Application Requirements in Section .0504 "Application Requirements for Sanitary Landfill" of the North Carolina Solid Waste Management Rules as amended, March 1991 and conforms with the scope of work detailed in Westinghouse Proposal No. GBW-B-P015, dated January 17, 1992.

United Metal Recyclers is located about one half mile northwest of Kernersville, North Carolina, on State Route 66. The proposed landfill is situated on a flat to gently sloping hilltop. Intermittent drainageways are in the watershed of Kernersville Lake. Land cover consists of mixed second or third growth hardwood forest and pine, interspersed with some open areas (Figure I).

Figure II shows the approximate locations of boreholes. Elevations range between 990 feet at the southeast corner near existing monitoring well MW-1 to 906 feet at borehole B-4. The slope of the upland area between boring B-7 and B-5 is approximately 2 percent. Steep side slopes of 15 to 25 percent occur at the northern and eastern end of the property. Slopes of around 5 percent occur on hillsides bordering the western edge of the property.

Purpose

An exploration program was performed to determine the general subsurface conditions in the proposed landfill area and to obtain geologic and hydrogeologic information required by the North

Carolina Solid Waste Management rules for the site permit application as included in NCAC T15A:13B .0504 (1)(c) excluding .0504 (1)(c)(i)(H), .0504 (i)(c)(ii), .0504 (1)(c)(iii) and .0504 (1)(c)(iv). The primary focus of this study was to characterize the geologic stratigraphy and hydrogeologic conditions of the 30+ acre site. On-site soils were evaluated as a potential source of liner and cover material. The results of field and laboratory tests are attached in the appendices to this report.

II. EXPLORATION PROCEDURES

A. Subsurface Investigation

Subsurface conditions were evaluated by means of eight soil test borings within the property at the approximate locations on the attached Boring Location Plan (Figure II). Borings were advanced to auger refusal or 85 feet +/- beneath existing site grade with a CME 550 drill rig mounted on an all-terrain vehicle (ATV) utilizing a 3 1/4 inch I.D. hollow stem auger to advance the borings. Standard penetration tests procedures (ASTM D-1586) were performed at selected intervals to evaluate the consistency and relative density of the in-situ soils. Split-spoon samples obtained from the standard penetration tests were visually classified in the field in accordance with the Unified Soil Classification System guidelines. Laboratory Grain Size Analysis, Natural Moisture Contents, Specific Gravities, and Atterberg Limits testing were performed on selected split-spoon samples to verify visual classification. A summary of field and laboratory test methods is presented in Appendix I.

Three bulk soil samples were selected for standard Proctor compaction tests (ASTM D-698) and remolded falling head permeability tests to evaluate the suitability of the borrow soils as liner and cover materials. A summary of laboratory tests conducted and test data are presented in Tables I, II, and III attached.

One borehole was selected for rock coring, extending ten feet into rock. The lithologic description plus Test Boring Records are contained in Appendix II. Generalized subsurface profiles prepared from test boring data are attached as Figures III and IV to graphically illustrate subsurface conditions. Detailed descriptions of subsurface characteristics encountered at the individual test boring locations are contained on the Test Boring Records (Appendix II).

B. History of Site Investigation

The only site investigation to be completed prior to the current study consisted of monitoring well installation for the existing landfill. The approximate location of monitoring well W-1 is shown on Figure II. Property surveys have also been completed as part of the permitting process.

The current investigation consisted of subsurface data gathering for characterization of soils and hydrogeologic factors. Eight boreholes were advanced throughout the site. The boreholes were fitted with piezometers at locations where groundwater was believed to be encountered. One borehole was cored in order to obtain data on lithologic characteristics.

C. Piezometer Installation

Four boring locations (B-2, B-4, B-7 and B-8) were selected for temporary piezometer installation for the purpose of evaluating the potentiometric surface and hydrogeologic characteristics of the property. The remaining boreholes were not completed with piezometers due to dry holes or shallow refusal depth. Piezometers consisted of 1.25 inch I.D. flush threaded schedule 40 PVC pipe. A ten foot screen section was fitted at the bottom.

The piezometers were constructed to enable isolation of a portion of the saturated zone, thus allowing aquifer tests for hydraulic conductivity to be conducted. Sand packs were placed around the slotted screened portion up to two feet above the top of the screen. A bentonite seal was placed above the sand pack to hydraulically isolate the screened interval. The remaining annular space was then filled with cuttings to the top of the hole and mounded to deflect rainfall from the piezometer.

D. Groundwater

Groundwater levels in piezometers were recorded using an electric water level probe by measuring the distance from the ground surface to the water level in the piezometer. The groundwater elevation was then determined using the estimated ground surface elevation obtained from an existing site map (Figure II). The estimation method was used because the piezometers had not been surveyed into existing control at the time of report preparation. Water levels were recorded at the time of boring, 24 hours, and at the time of field permeability tests.

E. Field Permeability Tests

Falling head slug tests were conducted on three piezometers using tap water and the electric water level probe. The data was used to calculate typical permeabilities in the saturated zone of the first surficial aquifer. Static water levels in each piezometer were measured prior to the addition of the slug. The time required for the water to drop predetermined distances was recorded. Raw data from the slug tests, as well as permeability calculations are contained in Appendix III.

F. Laboratory

A geologist visually examined each split-spoon sample to estimate grain size distribution, plasticity, moisture condition, color, presence of lenses or seams, and apparent geological origin. Soils were classified in accordance with the Unified Soil Classification System (USCS). Soil descriptions, classifications, and field results are presented on the individual test boring records, included in Appendix II.

Representative remolded samples of soils obtained during field exploration were tested in the S&ME laboratory in Charlotte, North Carolina. Classification tests included Natural Moisture Content, Grain Size Distribution (with sieve and hydrometer), Atterberg Limits, and Specific Gravity. In addition, Standard Proctor Compaction tests and Laboratory Falling Head Permeability tests were performed on selected bulk samples. A summary of the number of tests performed is provided in Table I.

G. Laboratory Permeability

The permeability of on-site soils was evaluated by performing laboratory permeability tests on three bulk samples of prospective cover and liner material. Permeability tests were performed on remolded samples compacted to approximately 95 percent of the standard Proctor (ASTM D-698) maximum dry density. Tests continued until steady state flow was achieved and relatively constant values of hydraulic conductivity were obtained. Results of the permeability tests are provided on the Summary of Laboratory Falling Head Permeability test data in Table III and on data sheets included in Appendix IV.

III. PHYSIOGRAPHY AND HYDROGEOLOGY

A. Physiography

North Carolina contains three physiographic provinces: Blue Ridge, Piedmont, and Coastal Plain. Forsyth County is located entirely in the Piedmont province. The Piedmont is characterized by gently rolling hills which formed by differential erosion of rocks due to local variations in resistance to weathering.

The area of investigation is located in the East Central part of Forsyth County. The topography is characteristically a hilltop location, bordered by gentle to steep slopes. The surface of the hilltop slopes gently to the north. The hilltop narrows to the north and is penetrated by relatively steep hillsides. Drainage is via wet weather drains which form a portion of the headwaters of Kernersville Lake, approximately one-half mile north of the site.

B. Regional Geology

The site is located in the Milton Litho-Tectonic Belt, which consists of a zone of metamorphic and granitic rocks, bordered by the slates of the Charlotte Belt to the south and Carolina Slate Belt to the east. It is bordered on the north and west by the Dan River Triassic Basin and the Sauratown Mountains Anticlinorium.

Published geologic information[1,2] indicates the site to be underlain by biotite gneiss and schist, containing abundant potassic feldspar and garnet, interlayered with calc silicate rock, mica schist, and amphibolite.

C. Site Geology

One rock core was obtained at boring B-8. Additionally, limited exposures of bedrock at the location of boring B-6 were observed. Other areas of the site contained residual soils which obscured the bedrock. At both the core and outcrop location (B-8 and B-6) the rock consisted of light gray to white, megacrystic biotite gneiss. Cores showed inclined foliation planes, estimated to range between 30° and 45°. The core was highly fractured with only a 50 percent recovery. Iron stained fractures were numerous on the sections of core which were recovered.

In the area around boring B-6, numerous large (5 foot) boulders were stockpiled in the area. They had been uncovered during excavation of soil material for the existing landfill. This would indicate a weathering pattern which could result in boulder formation at relatively shallow depths.

Two cross sections (Figure III and IV) were constructed from boring logs. The drawings indicate laterally consistent homogenous subsurface conditions in relation to material type. Residual soils occurred in two principal associations: 1) slightly sandy clayey silts to sandy silts and 2) medium to fine sands and silty sands. Densities increased with depth with silts ranging from stiff to hard and sands ranging from loose to dense. Depth to partially weathered rock was variable, ranging between 6 feet to none encountered.

Densities and other physical properties of these soils relative to liner and daily cover are discussed below in Section IV-B, Field and Laboratory Permeabilities.

D. Site Hydrology

Groundwater was encountered at only three boring locations (B-2, B-8, and B-20) additional groundwater levels were obtained from existing monitoring well MW-1. Based on the occurrence of groundwater in the boreholes certain generalities concerning site groundwater conditions are known. The depth to groundwater at most locations can be correlated with topographic position. Higher water elevations can generally be found beneath ridge lines and slopes; lower groundwater elevations can usually be found beneath drainage swales.

Reference to the cross sections (Figures III and IV) shows measured groundwater elevations at boreholes B-2, B-8 and B-4. Depth to groundwater at boring B-4 was approximately 17 feet. At borings B-8 and B-2, the depths ranged from 42 feet to 45 feet beneath ground surface. Inferences concerning groundwater elevation at other boring locations should be viewed cautiously since several of the borings did not achieve a depth sufficient to intercept the groundwater table. The inferred location of the potentiometric surface on the cross sections is based on best professional judgement, considering the existing information.

E. Site Soils

The soil survey of Forsyth County, North Carolina shows the three major soil types and associated phases occurring on the site. Excerpts of each mapped soil unit are contained below.[3]

Cecil Series (Cc)

The Cecil series consists of well drained, gently sloping to strongly sloping soils on uplands. They formed in residuum that weathered from granite, gneiss and other acidic rocks. The Cecil sandy loam phase (CcB) occurring on-site, has 2 to 6 percent slopes and occupies approximately 25 percent of the potential landfill area.

The solum ranges from 40 to 60 inches in thickness. Depth to bedrock is more than 5 feet. Mica flakes may be present in any horizon. The A horizon is grayish-brown to yellowish-red sandy loam to clay loam 3 to 10 inches thick. The B horizon is 37 to 50 inches thick. The B2t horizon is red clay. The lower part of the B2t horizon is mottled with yellow or brown in some places. In most places the B3t horizon is red clay loam, but in some places it is sandy clay. The B3t horizon is mottled with brown or yellow in places. The C horizon is weathered, red, acidic rock that crushes to sandy loam to clay that is mottled with brown and yellow in places.

Pacolet Series (Pa)

Approximately 25 percent of the site consists of pacolet soils. The series consists of well-drained, gently sloping to steep soils of the uplands. These soils formed in residuum that weathered from granite, mica gneiss, schist, and other acidic rocks. Three phases of the pacolet series occur on the site: 1) pacolet fine sandy loam 2-6 percent slopes, (PaB), 2) pacolet fine sandy loam, 6-10 percent slopes (PaC), and 3) pacolet clay loam, 10 - 15 percent slopes, eroded (PcD2).

The pacolet fine sandy loam phases differ primarily in range of slope. Topsoil and subsoil thicknesses are slightly less on the steeper phase. The pacolet clay loam occurs on narrow lower side slopes. It is generally shallower than the sandy loam phases.

The solum ranges from 20 to 40 inches in thickness. Depth to hard bedrock is more than 4 feet. The A horizon is brown, grayish brown, dark yellowish brown, yellowish brown, yellowish red or reddish brown. It is fine sandy loam or clay loam 3 to 9 inches thick. The B horizon is 17 to 31 inches thick. The B1 horizon is yellowish-red to strong-brown sandy clay loam or clay loam. The B2t horizon is red clay loam, clay or sandy clay, but in a few profiles the lower part of the B2t horizon is mottled with yellow or brown. The B3t horizon is red or yellowish-red clay loam or sandy clay loam but in some places it is mottled with brown or yellow. The C horizon is mottled red, yellow and brown, weathered rock that crushes to clay loam to sandy loam.

Wedowee - Louisburg Complex (We)

This unit consists of well drained to excessively drained soils on uplands. The complex consists of wedowee and louisburg soils that are so intricately mixed that they cannot be mapped separately. This complex occupies approximately 50 percent of the proposed landfill area.

The wedowee soil has a surface layer of yellowish brown to grayish brown sandy loam, 5 to 12 inches thick. The subsoil is yellowish red to yellowish brown clay to sandy clay loam 15 to 28 inches thick. The louisburg soil has a surface layer of yellowish brown to dark grayish brown loamy sand 5 to 10 inches thick. The subsoil is yellowish red to light yellowish brown sandy loam 4 to 12 inches thick.

IV. SUBSURFACE CONDITIONS

A. Test Boring Results

Figure V graphically illustrates subsurface conditions at the site. The profiles have been generalized and may not depict actual subsurface condition at boring locations. The actual subsurface transitions between material types are gradational and not abrupt as indicated the profiles. Detailed descriptions of the conditions encountered at the individual test boring locations are presented on the attached Test Boring Records (Appendix II).

Topsoil thickness was approximately 0.5 feet. Site preparation for drilling often resulted in topsoil removal in order to create a flat surface for the rig. Generally, topsoil consisted of a rooty, fibrous mat, with a medium to dark brown color.

Residuum

Aside from the topsoil layer, all soils were classified as residuum. It was characterized by slightly sandy clayey silts to sand and silty sand. Residuum thicknesses were highly variable between 12 feet (B-1, B-5 and B-6) to 50 feet (B-8). The low thickness at borings B-1, B-5 and B-6 may have been caused by the occurrence of boulders, the existence of which were noted above. At the other boring locations, residuum thicknesses ranged between 16 feet and 55 feet.

Partially Weathered Rock

Partially weathered rock is defined as residual material exhibiting a standard penetration resistance of 100 bpf or greater. When PWR was encountered, drilling progressed through the material until auger refusal or a depth of 50 feet, whichever came first. Depth to partially weathered rock ranged between 17 feet to none encountered.

Auger Refusal

Auger refusal material is defined as any material that cannot be penetrated by the soil drilling equipment used on the drilling project. Most holes reached refusal prior to the planned 50 foot termination depth. Depths to refusal ranged between 12 and 50 feet.

B. Field and Laboratory Permeabilities

Field

Falling head permeability tests were conducted on piezometers B-2 and B-8 to measure the typical permeability values of the top aquifer materials. The static height of the water in each piezometer was measured with an electric water level meter prior to the addition of the slug. The rise in head was accomplished using tap water. The time for the height of the column of water to reach predetermined levels was recorded. The raw data from the slug tests as well as the permeability calculations are included in Appendix III. The Rice-Bouwer[4] equations for an unconfined aquifer were used to calculate the permeability from the field tests. Inevitably, during construction of the piezometers, smear occurs along the borehole in all thereby reducing the apparent permeability. Therefore, the slug test produces permeability values which probably represent minimums. The results of the tests indicate the following in-situ permeabilities in the saturated zone:

Piezometer No. B-2: 5.4×10^{-5} cm/sec
Piezometer No. B-8: 9.1×10^{-6} cm/sec

A slug test was also attempted in piezometer B-4. However, rapid infiltration of the slug resulted in a minimal rise in water level in the casing. It was determined that rapid movement of water to the aquifer occurred. It is possible that piezometer B-4 intercepted a fracture or series of fractures, resulting in the observed rapid infiltration.

<u>Laboratory Permeability</u>

Laboratory permeability testing was performed on three remolded (bulk bag) samples obtained from test borings. The remolded samples were compacted in accordance with ASTM D-698 at moisture contents within 3 to 4 percent wet of optimum. This moisture range was selected to simulate the soil moisture content likely to be utilized for liner construction.

The remolded samples were encapsulated in a rubber membrane and placed in a triaxial type permeability cell. An effective confining stress of 2 psi was used to establish a tight fit between the membrane and the sample. Test specimens were saturated under a back pressure of 100 psi prior to running the falling head permeability test. The permeability tests were performed with an effective confining pressure of 2 pounds per square inch (psi) and hydraulic heads of about 40 centimeters (cm) of water across typical samples lengths of 7.25 to 7.8 cm. Inflow and outflow during each test was monitored and the hydraulic conductivity was calculated from each recorded increment. The soil samples collected were the potentially low permeability materials planned for use as liner and top cover material in the development of the proposed landfill.

Following completion of the falling head permeability tests, representative samples were subjected to specific gravity, Atterberg Limits, and Grain Size Analysis to further characterize the on-site soils. Results of the permeability testing including hydraulic conductivity, porosity, molding conditions, and the classification based on the Unified Soil Classification System are contained in Table III.

Table III indicates that the lowest permeable soils sampled and tested were taken from remolded bag samples of boring B-5 (1.5×10^{-7} cm/sec). Boring B-8 achieved a permeability of roughly twice that of boring B-5. The most permeable soil was that of boring B-2 (2.0×10^{-6}) or roughly one order of magnitude greater than either borings B-5 or B-8.

Twelve of the fifteen soil samples selected for index testing were classified under the Unified Soil Classification System as SM. The remainder were MH. Material classified as SM is described as silty sands and sand-silt mixtures. MH soils are inorganic silts or diatomaceous fine sandy or silty soils.

For purposes of liner construction, using components from on-site soils, those materials classified as SM or MH could be expected to provide low permeability characteristics. Reference to Table II, Summary of Laboratory Test Data indicates most of the site may contain these types of soil. Additional sampling and testing of soils from potential borrow areas is recommended if these soils are to be used as liner components, to better define available quantities of such material.

V. CONCLUSIONS AND PRELIMINARY RECOMMENDATIONS

A. General Site Suitability

Much of the property would be suitable for landfilling under current North Carolina Regulations. Soil densities, depths, and physical characteristics should pose no obstacle to construction of cells for waste placement. Several areas may contain suitable soils, when properly compacted, for use as components in a liner system. Soils classified as SM would have the greatest likelihood of providing permeability characteristics for use in composite liners.

The occurrence of groundwater beneath hilltops should present few problems in relation to seasonal high water levels. However, additional water monitoring should be completed in order to define the seasonal high water table at the site. Additional deep piezometers may be constructed to provide more complete groundwater data.

B. Construction Considerations

Excavation Characteristics

The residual soils at the site can generally be excavated using conventional equipment such as pans, scrapers, backhoes, and dozers. Based on our past experience with similar materials, the hard to very dense materials exhibiting standard penetration resistances as hard as 50 blows per 3 inches of penetration to 100 bpf will require preloosening by ripping during general site grading to expedite excavation procedures. This can be performed using conventional methods by first loosening the materials with a single-toothed ripper attached to a suitable size dozer such as a Caterpillar D8 or D9.

Liner

Based on laboratory soil permeability data contained in Table III, soils exhibiting the lowest permeability were classified as SM. It is our opinion that the silty sands (SM) and some areas of MH soils, recompacted to between 95 to 100 percent of the standard Proctor maximum dry density will provide hydraulic conductivity values in the field on the order of 5 x 10^{-7} cm/sec to 1 x 10^{-7} cm/sec. These soil types are widely distributed over the site. All borings contained either SM or MH soils in the upper 10 feet. Sufficient quantities of on-site soils would appear to exist for utilization as liner materials, based on the boring data. However, additional borings and laboratory analysis of samples would allow accurate quantities to be calculated.

Additive enrichment of on-site materials is an alternative to obtaining off-site soils for use as liner materials if sufficient on-site quantities are not available. If additive enriched soils are used, hydraulic conductivity values on the order of 1 x 10^{-7} cm/sec can be obtained. This would enable the use of a larger quantity of the on-site materials to be used and reduce or eliminate the use of off-site materials.

The most common additive is the mineral bentonite which exhibits a high swell characteristic, typically 15 times its dry volume. A typical bentonite based product, Volclay, is produced by American Colloid Company. Similar products are produced by other companies. No endorsement of any particular product is hereby made.

The quantity of bentonite required to achieve the desired permeability is a function of the soil type to be utilized. Typical rates range between 5 and 20 pounds of bentonite per cubic foot of soil. Prior to specifying a mixing rate, prospective liner materials should be sampled and tested by both the manufacturer of the sealant additive (bentonite).

Proper selection and construction of liner material will be an important aspect for successful utilization of the liner. If on-site soils are used, selection and separation of these materials in the field should be based upon classification testing and evaluation by an experienced soils technician working directly under the supervision of a geotechnical engineer. Liner soils should contain no more than 40 percent of materials coarser than a No. 200 sieve with less than 5 percent retained on a No. 4 sieve and have a Plasticity Index greater than 10 percent with associated Liquid Limits of at least 25 percent. It is our opinion that these soils can be found within the property boundary. The contractor should separate liner material from general fill and not include rock fragments, cobbles, or organic materials with potential liner soils.

References

1. Brown, Phillip M., 1985. Geologic Map of North Carolina. North Carolina Department of Natural Resources and Community Development.

2. Espenshade, G.H., Rankin, D.W., et al, 1975. Geologic Map of the East Half of the Winston-Salem Quadrangle, North Carolina, Virginia, U.S. Geological Survey, Map I-709-B

3. Zimmerman, James L., 1976. Soil Survey of Forsyth County, North Carolina, U.S. Department of Agriculture.

4. Bouwer, Herman, 1989. The Bouwer and Ric Slug Test. An Update. Groundwater, May-June, 1989.

TABLE I

SUMMARY OF LABORATORY AND FIELD TEST CONDUCTED

Type of Test	Test Number
Moisture Content	15
Grain Size Wash 200	15
Grain Size Hydrometer	15
Atterberg Limits	12
Standard Proctor	3
Saturated Hydraulic Conductivity (Lab)	3
Saturated Hydraulic Conductivity (Field)	2
Volume % Water	3
Porosity	3

TABLE II
SUMMARY OF LABORATORY TEST DATA

Location	Depth (ft.)	Type Sample	Natural Moisture Content (%)	Percent Passing #200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index	Unified Soils Classification
1	8.5-10	SS	14.6	17.3	--	--	--	SM
2	1-10	Bag	13.6	71.6	53	38	15	MH
2	3.5-5	SS	29.9	39.2	55	53	2	SM
2	13.5-15	SS	21.7	37.4	45	--	NP	SM
3	8.5-10	SS	16.8	31.8	40	--	NP	SM
4	1-10	Bag	15.4	35.9	39	17	12	SM
5	1-10	Bag	29.8	42.7	34	24	10	SM
7	1-10	Bag	21.1	45.3	32	27	5	SM
7	3.5-5	SS	15.3	28.3	31	--	NP	SM
7	8.5-10	SS	8.7	32.2	31	--	NP	SM
8	1-10	Bag	21.4	68.4	52	35	17	MH
8	3.5-5	SS	21.3	65.4	64	47	17	MH
8	8.5-10	SS	19.0	41.2	49	--	NP	SM
8	13.5-15	SS	15.1	36.1	--	--	--	SM
8	13.5-15.0	SS	16.1	18.1	--	--	--	SM

SS - Split-Spoon
Bag - Composite of Cuttings From 0-10'

TABLE III

SUMMARY OF LABORATORY FALLING HEAD PERMEABILITY TEST DATA

Location	Depth (ft.)	Max. Dry Density (lb/ft3)	Std. Proct. Opt. Moist. Content (%)	Compaction Moisture	Dry Density (lb/ft(3)	Permeability Ave. (k) cm/sec	Porosity (%)	Unified Soil Classification
2	1-10	94.8	25.8	29.5	89.3	2.0x 10(-6)	53	MH
5	1-10	114.0	14.8	17.9	108.0	1.5 x 10(-7)	64	SM
8	1-10	103.3	19.0	22.0	98.4	3.0 x 10(-7)	58	MH

SHEET NO 1 OF 1

CALCULATED BY ______ DATE ______

CHECKED BY ______ DATE ______

SCALE As Shown

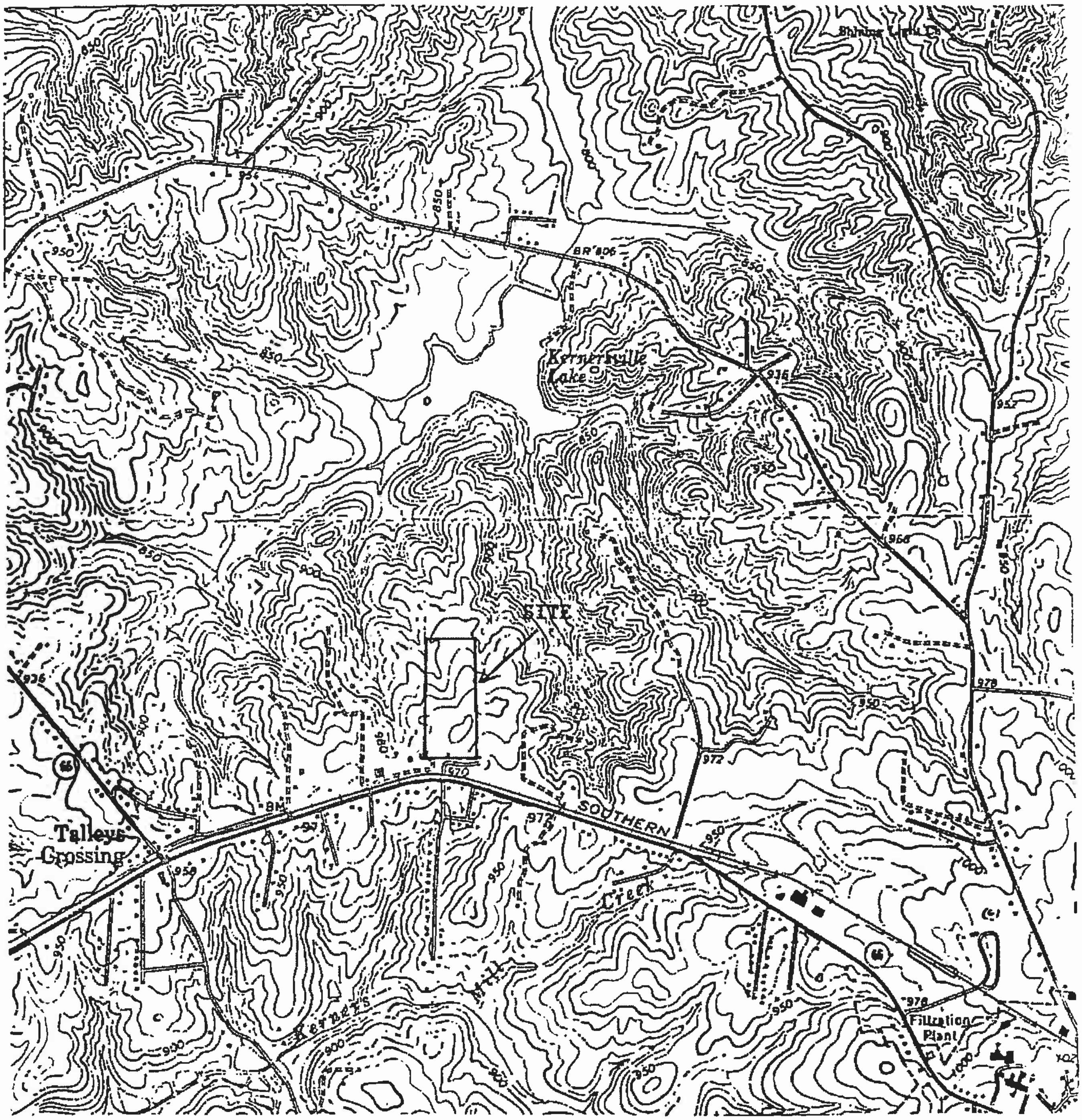
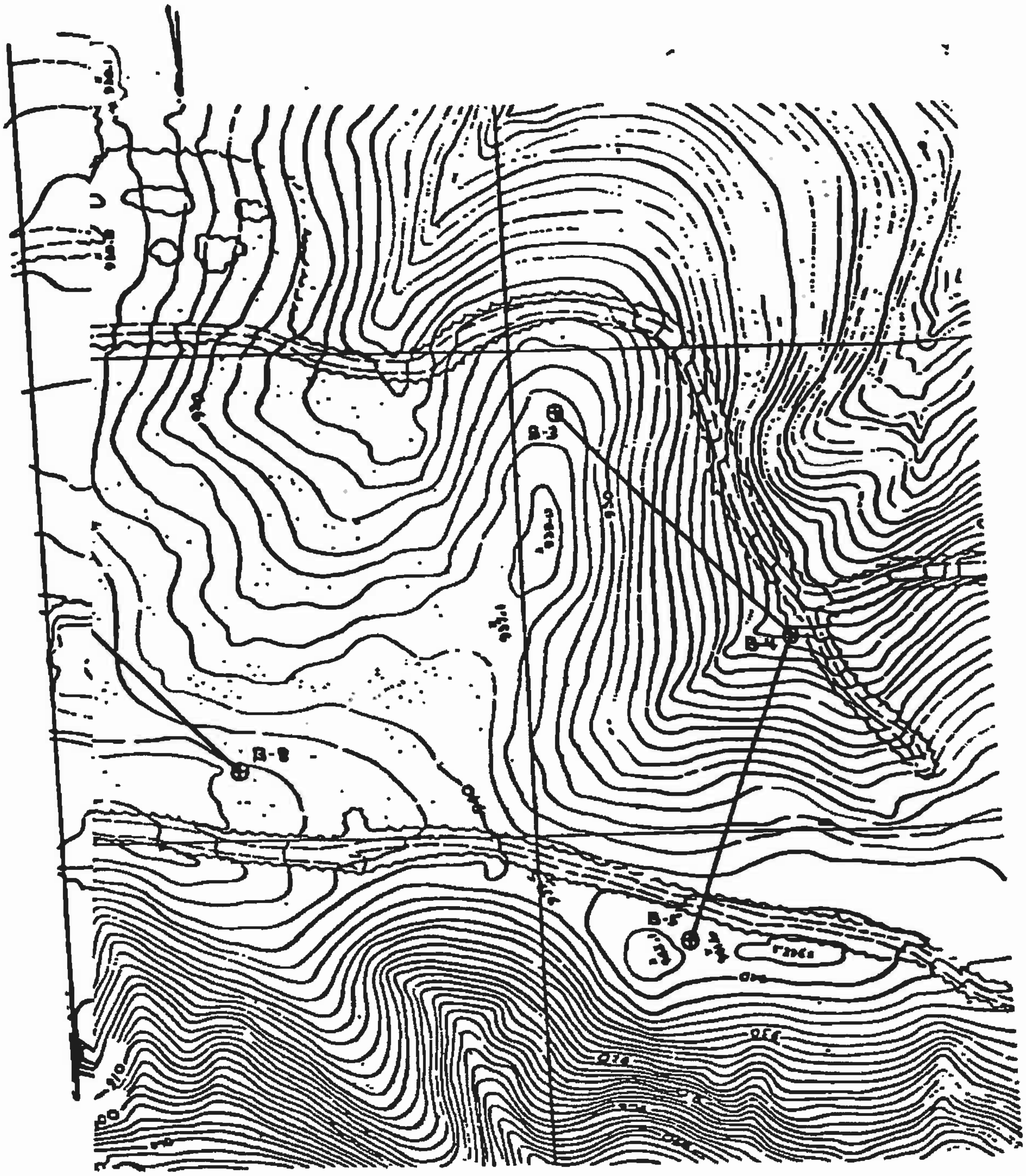


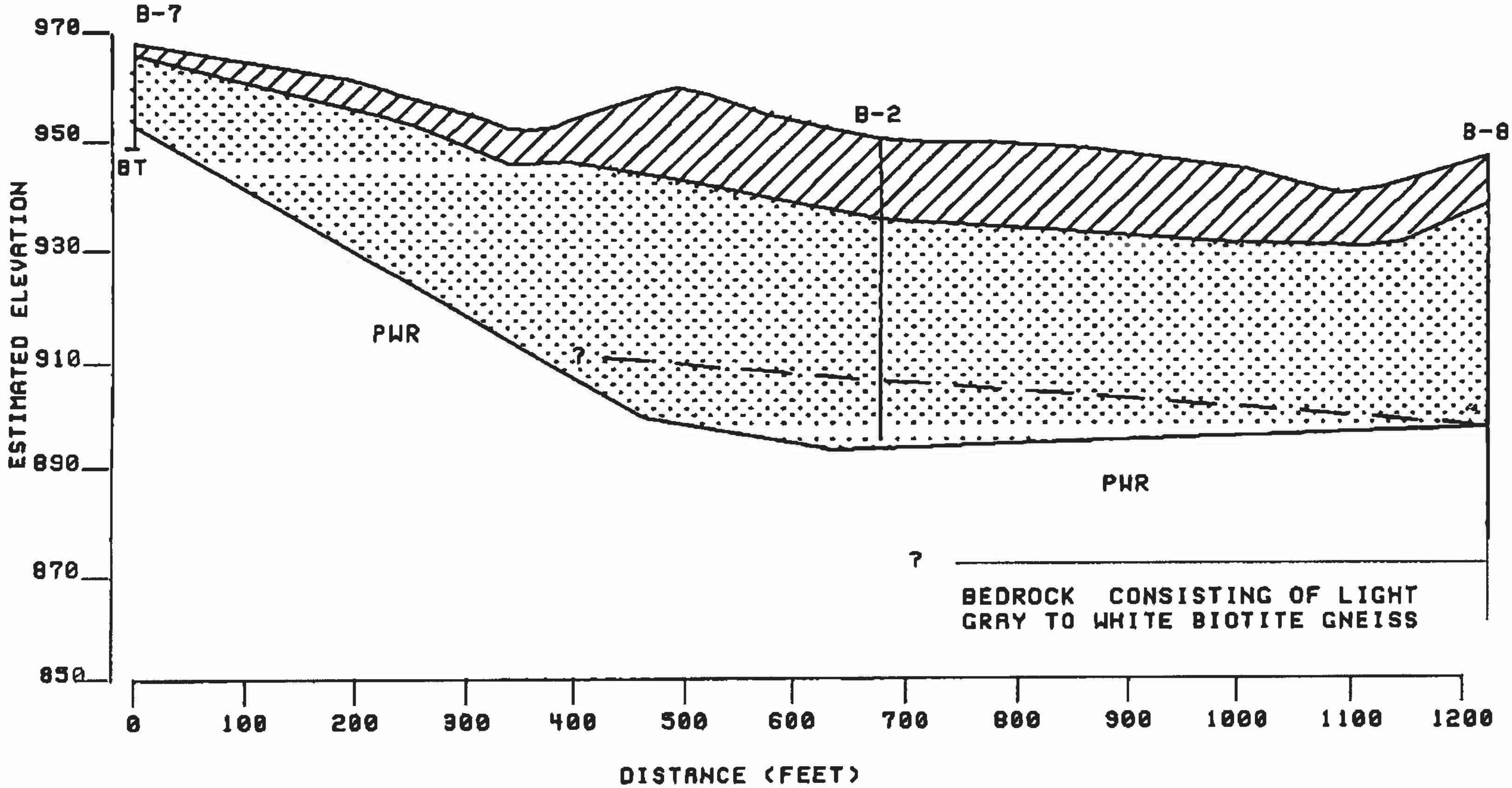
Figure I
Location Map

N
0' 2000'

Source: Belews Creek 7.5' Quadrangle


B-3
B-4
B-5
B-8

UNITED METAL RECYCLERS
GENERALIZED CROSS SECTION
SHOWING RESIDUUM, PWR
AND POTENTIOMETRIC SURFACE



KEY

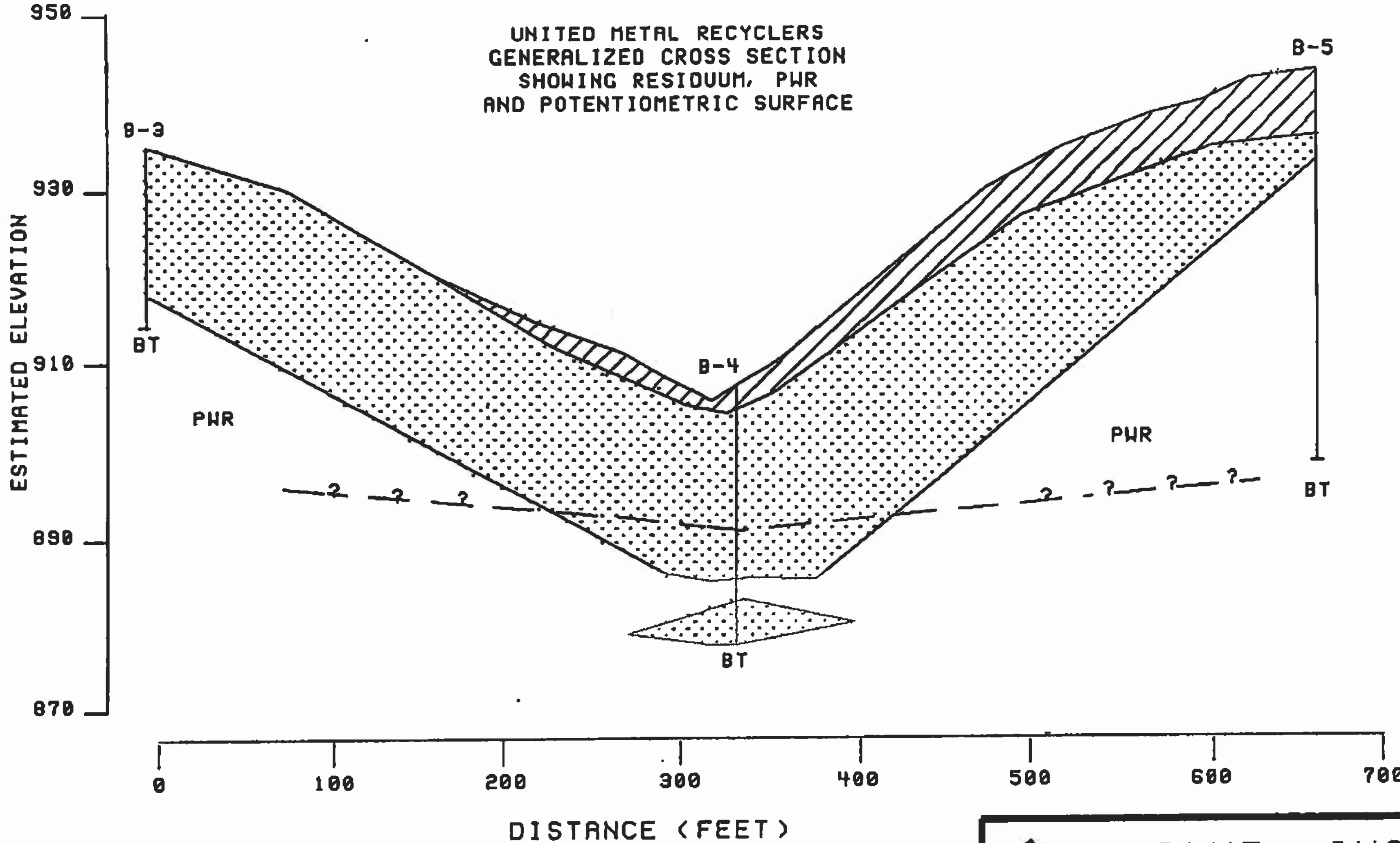
- SLIGHTLY SANDY CLAYEY SILTS TO SANDY SILTS
- MEDIUM TO FINE SAND AND SILTY SAND
- ESTIMATED POTENTIOMETRIC SURFACE ELEVATION (2/21/92)
"?" - INDICATES UNCERTAIN CORRELATION DUE TO LACK OF DATA

S&ME, INC.
GREENSBORO, NORTH CAROLINA

DATE:	APPROVED BY:	DRAWN BY:
03-13-92		VLR

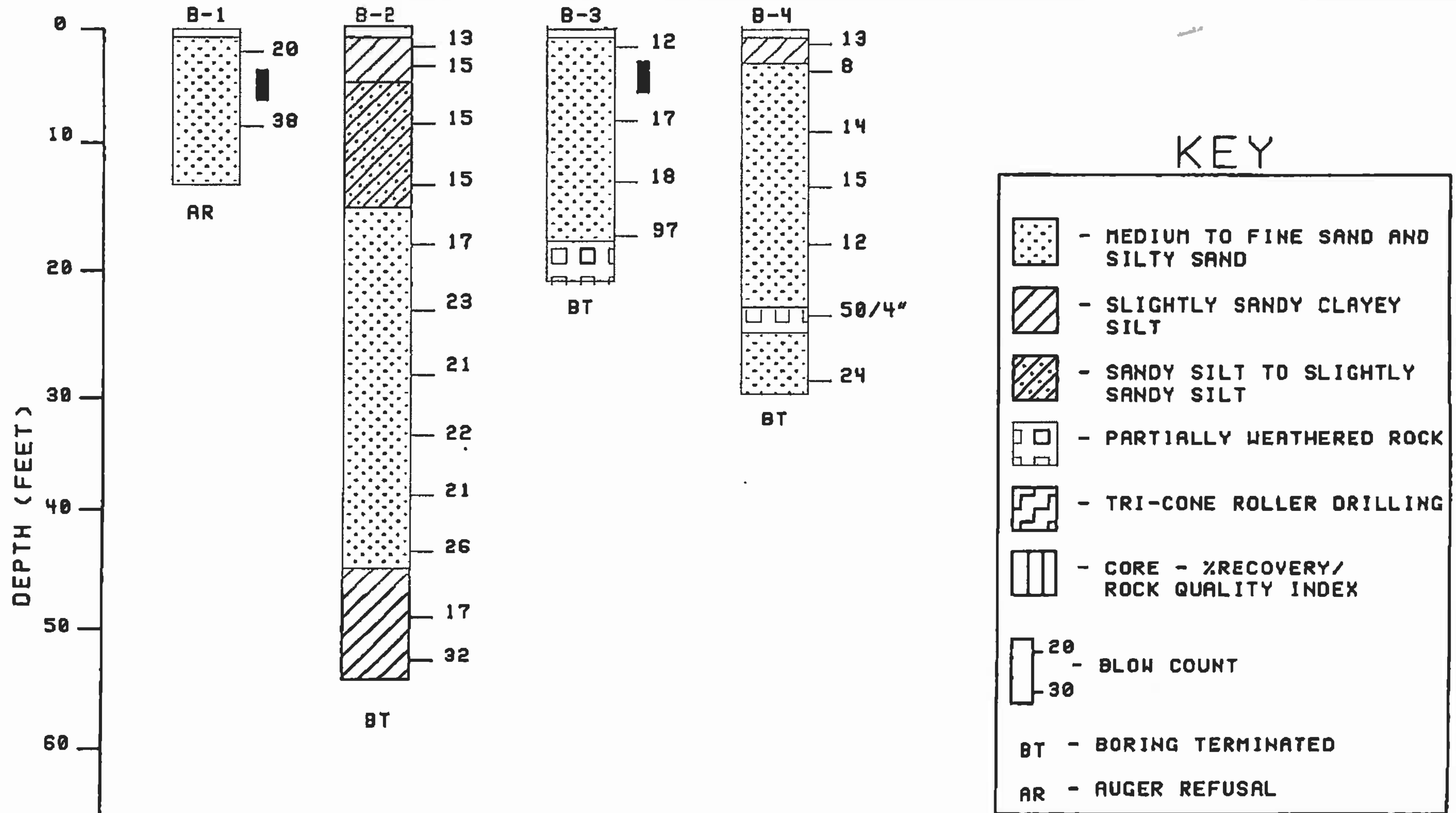
UNITED METAL RECYCLERS

CROSS SECTION | DRAWING NO. FIGURE III



SEE LEGEND ON
DRAWING 050-1

S&ME, INC. GREENSBORO, NORTH CAROLINA		
DATE: 03-12-92	APPROVED BY:	DRAWN BY: VLR
UNITED METAL RECYCLERS		
CROSS SECTION		DRAWING NO. FIGURE IV



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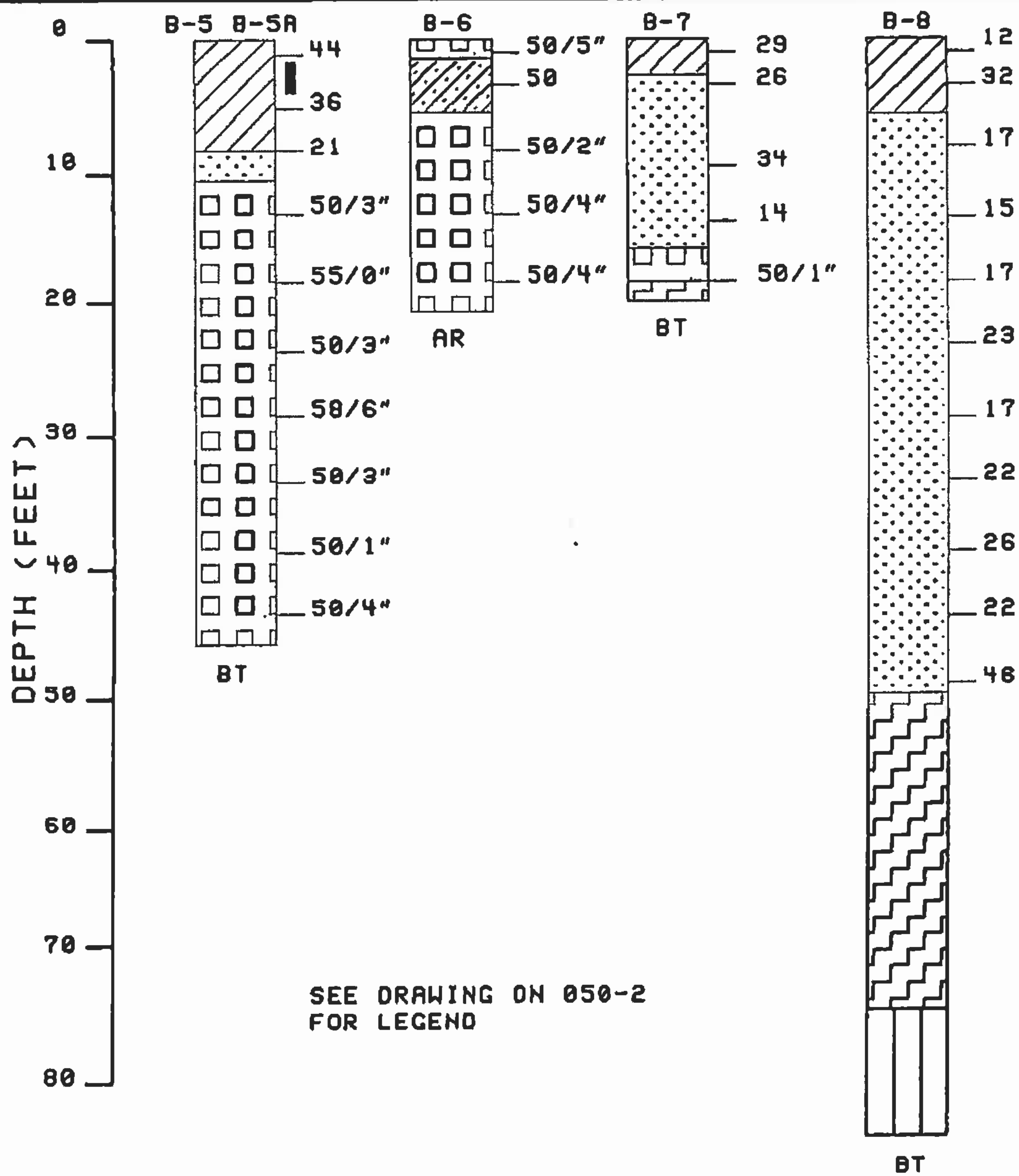
GREENSBORO, NORTH CAROLINA

DATE:	APPROVED BY:	DRAWN BY:
03-12-92		VLR

UNITED METAL RECYCLERS

	DRAWING NO.
SUBSURFACE PROFILE	FIGURE V



SEE DRAWING ON 050-2
FOR LEGEND

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DATE:	APPROVED BY:	DRAWN BY:
03-12-92		VLR

UNITED METAL RECYCLERS

	DRAWING NO.
SUBSURFACE PROFILE	FIGURE V

FIELD AND LABORATORY METHODS

SOIL TEST BORINGS

Borings were advanced with 3-1/4 inch hollow-stem augers and, at standard intervals, soil samples were obtained with standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows, designated as Standard Penetration Resistance, when properly evaluated is an index to soil strength and relative density.

Representative portions of each split-tube sample were placed in glass jars and classified by a geologist in our laboratory. Laboratory analyses of plasticity, grain size, and specific gravity were used to confirm visual classifications. Test Boring Records showing the soil descriptions and standard Penetration Resistances are included in Appendix III.

MOISTURE CONTENT

The moisture content of several samples was determined. The moisture content is the ratio of the weight of water in a given mass of soil to the dry weight of the solids. This test was conducted in accordance with ASTM Designation D 2216-66. Test results are presented on the attached Summary of Laboratory Data Sheet (Table II).

GRAIN SIZE TESTS

Grain size tests were performed to examine the particle size and distribution of the bulk samples tested. Grain size distribution of soils coarser than a No. 200 sieve was determined by passing the samples through a set of nested sieves. Soil particles passing the No. 200 sieve were suspended in solution and the grain size distribution determined from the rate of settlement. The results are presented on the attached Summary of Laboratory Data Sheet, Table II.

SOIL PLASTICITY TESTS (ATTERBERG LIMITS)

Samples were selected for Atterberg limits testing to determine the soil's plasticity characteristics. Plastic Index (PI) is representative of this characteristic and is the difference between the Liquid Limit (LL) and the Plastic Limit (PL). Liquid Limit is the moisture content at which the soil will flow as a heavy viscous fluid as determined in accordance with ASTM D-423. Plastic Limit is the moisture content at which the soil begins to loose its plasticity as determined in accordance with ASTM D-424. Analytical data is presented in Table II.

KEY TO
TEST BORING RECORDS

ABBREVIATIONS

Alluv.	Alluvium
Res.	Residual
PWR	Partially Weathered Rock
Mica.	Micaceous
C	Coarse
M	Medium
F	Fine
Sli.	Slightly
w/	With
V.	Very
TOB	Termination of Boring

SYMBOLS

Groundwater Level at TOB

24-Hour Groundwater Level

Undisturbed Sample

NOTES:

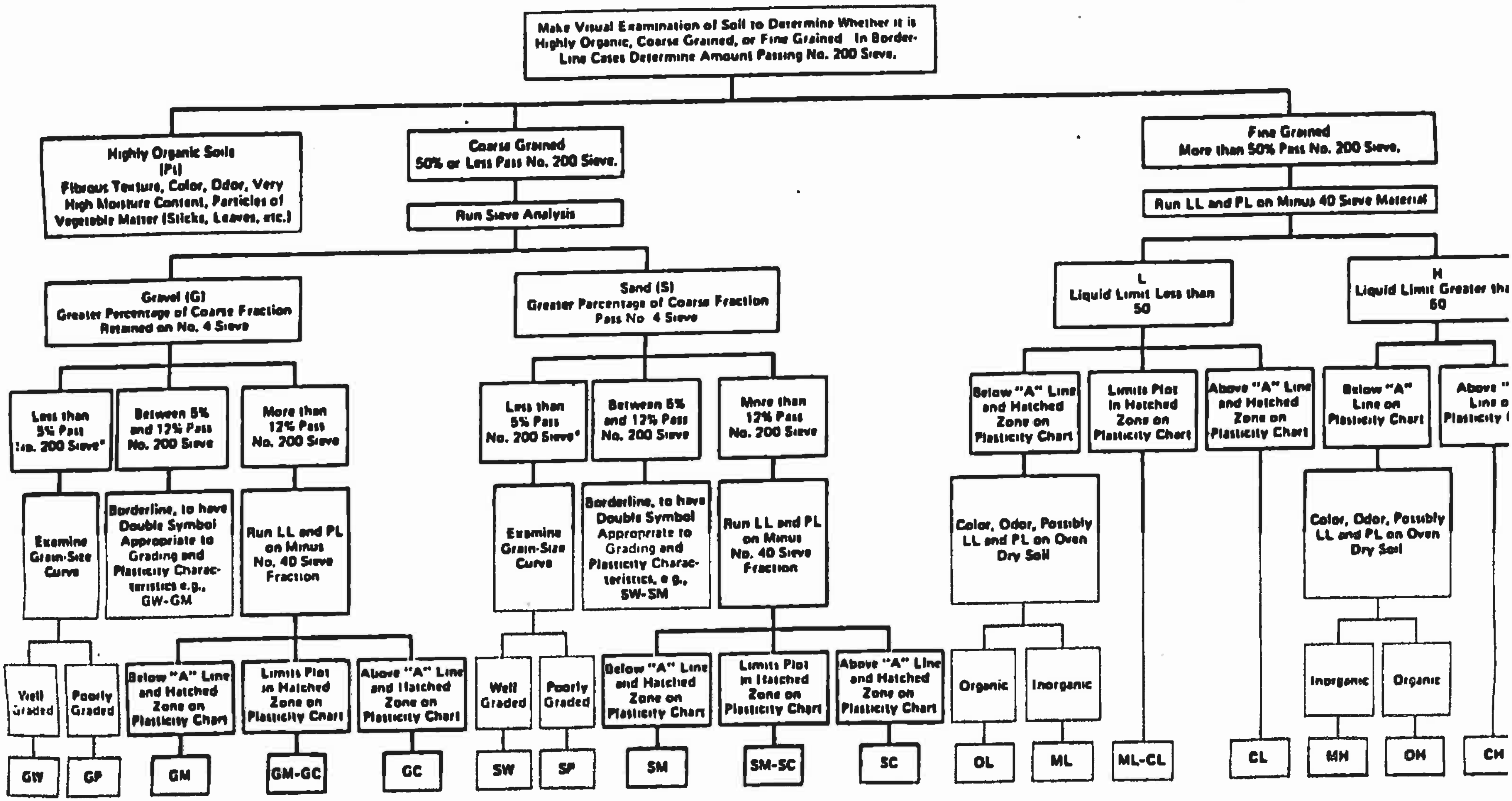
1. Boring and sampling satisfy ASTM D-1586. Core Drilling satisfies D-2113.

2. "Blows per six inches" (N-value) refers to the number of a 140-lb. hammer falling 30 inches to drive a 1.4-inch inner diameter split-spoon sampler six inches. Three consecutive six-inch "drives" are executed at each sampling depth, except when material requiring 50 or more blows per six inches (e.g. 50/3") is encountered. In this case, the sampling at that particular depth is terminated in the drive where the "50+" material occurs.

3. "Penetration" (blows per foot) is a numerical quantity calculated at each sampling depth by summing the blows for the last two six-inch increments. In the case of a partial drive (e.g. 50/3"), a value of 100 is assumed. A graphical representation of penetration values is plotted to the left of "blows per six inches" on the Test Boring Records.

4. Recovery (REC), is a term used to describe the retrieved quantities of both soil and rock samples. When associated with soil sampling, it is the retrieved length, in inches, of the split-spoon sample. The maximum is 18 inches. With respect to rock coring, recovery is the ratio of the retrieved length of rock core to the length of the core run times 100%.

5. The Rock Quality Designation (RQD) is the ratio of the cumulative length of those core segments 4 inches or longer to the total length of the core run times 100%. When calculating RQD, mechanical fractures caused by drilling and/or core retrieval are discounted.



Note: Sieve Sizes are U S. Standard.
*If Fines Interfere with Free Draining Properties use Double Symbol such as GW-GM, etc.

UNIFIED SOIL CLASSIFICATION SYSTEM

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION		ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil		980.0			
0.5	Firm, Red-Yellow, Slightly Silty Medium to Fine Sand- Residuum	SM			4-8-12	
4.0	Dense, Red-Orange, Slightly Silty, Medium to Fine Sand	SM	975.0		10-17-21	
			970.0			
12.5	Auger Refusal					
			965.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-1
DATE 01/28/92

PAGE 1 OF 1

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION		ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil		950.0			
0.5	Stiff, Red-Orange, Slightly Coarse to Medium Sandy, Slightly Clayey Silt-Residuum	MH SM			3-6-7	
					5-7-8	
5.0	Stiff, Tan to Pink to Orange, Slightly Medium to Fine Sand	SM	945.0		4-8-7	
			940.0		4-7-8	
15.0	Firm to Very Firm, Red, Pink, and White Slightly Silty, Medium to Fine Sand, Fine Micaceous	SM	935.0		6-9-8	
			930.0		8-11-12	
			925.0		7-10-11	
			920.0		5-11-11	
			915.0		6-10-11	

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-2
DATE 01/28/92

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION		ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
			910.0		7-13-13	
45.0	Very Stiff to Hard, Tan, Slightly Fine Sandy Silt	SM	905.0		3-8-9	
			900.0		10-14-18	
55.0	Boring Terminated Set Piezometer at 54 Feet		895.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-2
DATE 01/28/92

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION		ELEVATION (FT.)	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil		935.0		
0.5	Stiff, Red-Brown, Clayey Silt, Fine Micaceous- Residuum	MH		3-6-6	
3.0	Firm, Red-Brown, Silty, Medium to Fine Sand, Micaceous, With Fragments of Biotite Granite, 1/2" - 1"	SM	930.0	7-8-9	
11.0	Firm, White to Tan, Medium to Fine Sand, Fine Micaceous	SM	925.0	7-8-10	
16.0	PWR Sampled as White to Black, Coarse to Fine Sand, Fine Micaceous		920.0	17-22-75	
21.0	Auger Refusal		915.0		
			910.0		

PENETRATION (BLOWS/FT.): 0, 10, 20, 30, 50

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-3
DATE 01/29/92

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION		ELEVATION (FT.)	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil		906.0		
0.5	Stiff, Red-Orange, Medium to Fine Sandy Clayey Silt, Micaceous-Residuum	MH		4-6-7	
3.0				5-4-4	
	Loose, Red-Orange to Tan, Slightly Silty, Medium to Fine Sand	MH	901.0		
6.0	Firm, Tan to White, Medium to Fine Sand	SM		7-7-7	
			896.0	5-8-7	
			891.0	4-5-7	
			886.0		
23.0	PWR Sampled as Tan to White, Medium to Fine Sand			50/4.0"	
25.0	Very Firm, Tan to White, Medium to Fine Sand	SM	881.0	21-11-13	
30.5	Boring Terminated Set Piezometer at 28 Feet		876.0		
			871.0		

PENETRATION (BLOWS/FT.) 0 10 20 30 50

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-4
DATE 01/29/92

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION		ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil	MH	942.0			
0.5	Hard Red-Orange, Coarse to Fine Sandy Slightly Clayey Silt- Residuum	SM			22-22-22	
					12-18-18	
5.0	Auger Refusal, Offset 5'		937.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-5
DATE 01/30/92

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION		ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Auger Probe		942.0			
			937.0			
8.5	Very Firm, White to Tan, Coarse to Fine Sand- Residuum	SM			8-9-12	
11.0	FWR Sampled as White to Tan, Coarse to Fine Sand		932.0			
					21-29-50/3.0"	
			927.0			
					31-55-0	
			922.0			
					50/3.0"	
			917.0			
					44-58-0	
			912.0			
					50/3.0"	
			907.0			
					50/1.0"	

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-5A
DATE 01/30/92

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
		902.0	50/4.0"		
46.0	Boring Terminated	897.0			
		892.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-5A
DATE 01/30/92

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION		ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Dozer Cut Through 6+/- Feet of Residuum - PWR Sampled as White, Brown and Black, Coarse to Fine Sand		951.0		50/5.0"	
3.5	Dense, White and Black Coarse to Fine Sand	SM			17-32-18	
6.0	PWR		946.0		50/2.0"	
			941.0		15-30-50/4.0"	
			936.0		16-26-50/4.0"	
20.5	Auger Refusal		931.0			
			926.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-6
DATE 01/28/92

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION		ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
0.0	Topsoil		969.0			
0.5	Very Stiff, Red-Orange, Slightly Fine Sandy, Slightly Clayey Silt- Micaceous- Residuum	MH SM			4-11-18	
3.0					33-15-11	
	Very Firm to Dense, Black, White, Gray, Medium to Fine Sand, Sparse Rock Fragments (1/2") Biotite Granite	SM	964.0		16-22-12	
11.0	Firm, Red, Black, White, Medium to Fine Slightly Silty Sand, Micaceous	SM	959.0		8-8-6	
16.0	PWR Sampled as White, Gray to Black, Coarse to Medium Sand		954.0		50/1.0"	
18.5	Tri-Cone Roller Bit					
19.7	Boring Terminated Set Piezometer at 18 Feet		949.0			

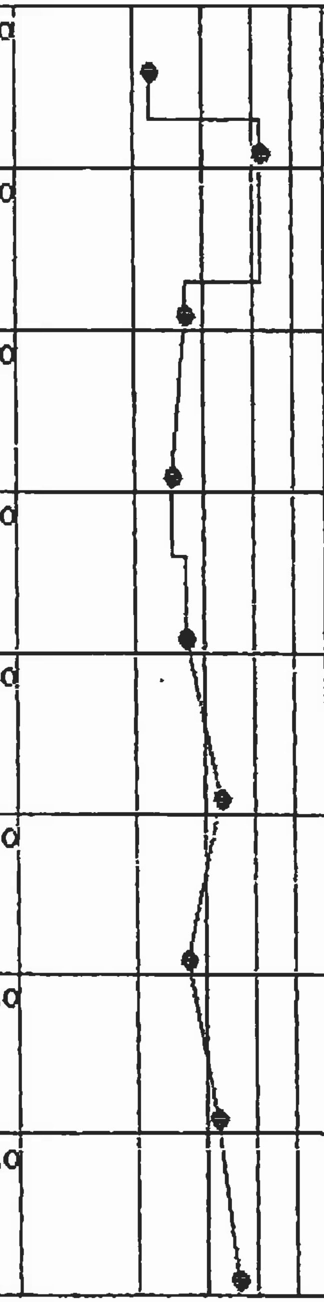
REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-7
DATE 01/28/92

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION		ELEVATION (FT.)
0.0	Topsoil		944.0
0.5	Stiff, Red-Orange, Slightly Fine Sandy Clayey Silt- Fine Micaceous-Residuum	MH	
3.5	Hard, Red-Orange, Slightly Medium to Fine Sandy, Clayey Silt, Fine Micaceous	MH	939.0
8.5	Firm, Tan, Slightly Silty, Medium to Fine Sand	SM	934.0
			929.0
17.0	Firm to Very Firm, Brown, Silty, Fine Sand, Abundant, Fine Micaceous	SM	924.0
			919.0
			914.0
			909.0

PENETRATION (BLOWS/FT.) 0 10 20 30 50



BLOWS PER SIX IN.	REC. (IN.)
4-4-8	
9-15-17	
6-8-9	
6-7-8	
7-7-10	
7-11-12	
6-7-10	
8-11-11	
8-11-15	

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-8
DATE 01/30/92

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION		ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
			904.0		9-9-13	
46.0	Dense, Brown, Silty Fine Sand, Abundant, Fine Micaceous	SM	899.0		10-18-28	
50.0	Tri-Cone Roller Bit		894.0			
			889.0			
			884.0			
			879.0			
			874.0			
75.0	Core, See Attached Description		869.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-8
DATE 01/30/92

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.	REC. (IN.)
		864.0			
85.0	Boring Terminated Set Piezometer at 76.5 Feet Mud in Hole at TOB, 24 Hours	859.0			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER GBW-B-050
BORING NUMBER B-8
DATE 01/30/92

Core Description

B-8

Recovery = 50%
RQD = 23%

75-85' Light gray to white, biotite gneiss, megacrystic, inequigranular (1-5 mm). White minerals of quartz and K-feldspar in bands (0.1" - 0.5") steeply inclined banding, ranges between 30 and 45 degrees. Sparse iron stained fractures at one location in core.